BeneView T8

Patient Monitor

Operation Manual

CE Marking

The product bears CE mark indicating its conformity with the provisions of the Council Directive 93/42/EEC concerning medical devices and fulfils the essential requirements of Annex I of this directive.

The product is in radio-interference protection class A in accordance with EN55011.

The product complies with the requirement of standard EN60601-1-2 “Electromagnetic Compatibility – Medical Electrical Equipment”.

Revision History

This manual has a revision number. This revision number changes whenever the manual is updated due to software or technical specification change. Contents of this manual are subject to change without prior notice. Revision 1.0 is the initial release of the document.

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⚠ WARNING

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Preface

Manual Purpose

This manual contains the instructions necessary to operate the Patient Monitor safely and in accordance with its function and intended use. Observance of this manual is a prerequisite for proper product performance and correct operation and ensures patient and operator safety.

This manual is based on the maximum configuration and therefore some contents may not apply to your monitor. If you have any question, please contact us.

This manual is an integral part of the product. It should always be kept close to the equipment so that it can be obtained conveniently when needed.

Intended Audience

This manual is geared for clinical professionals who are expected to have a working knowledge of medical procedures, practices and terminology as required for monitoring of critically ill patients.

Illustrations

All illustrations in this manual serve as examples only. They may not necessarily reflect your monitoring setup or data displayed on your patient monitor.

Conventions

- ***Italic*** text is used in this manual to quote the referenced chapters or sections.
- [ ] is used to enclose screen texts.
- → is used to indicate operational procedures.

FOR YOUR NOTES

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1 Safety

1.1 Safety Information

⚠ DANGER

- **Indicates an imminent hazard that, if not avoided, will result in death or serious injury.**

⚠ WARNING

- **Indicates a potential hazard or unsafe practice that, if not avoided, could result in death or serious injury.**

⚠ CAUTION

- **Indicates a potential hazard or unsafe practice that, if not avoided, could result in minor personal injury or product/property damage.**

NOTE

- **Provides application tips or other useful information to ensure that you get the most from your product.**

1.1.1 Dangers

There are no dangers that refer to the product in general. Specific “Danger” statements may be given in the respective sections of this manual.

1.1.2 Warnings

⚠ WARNINGS

- **Before putting the system into operation, the operator must verify that the equipment, connecting cables and accessories are in correct working order and operating condition.**
- **The equipment must be connected to a properly installed power outlet with protective earth contacts only. If the installation does not provide for a protective earth conductor, disconnect it from the power line and operate it on battery power, if possible.**
- **To avoid explosion hazard, do not use the equipment in the presence of flammable anesthetics, vapors or liquids.**
- **Do not open the equipment housings. All servicing and future upgrades must be carried out by the personnel trained and authorized by our company only.**
- **When using the equipment with electrosurgical units (ESU), make sure the patient is safe.**
- **Do not come into contact with patients during defibrillation. Otherwise serious injury or death could result.**
- **Do not rely exclusively on the audible alarm system for patient monitoring. Adjustment of alarm volume to a low level or off may result in a hazard to the patient. Remember that alarm settings should be customized according to different patient situations and always keeping the patient under close surveillance is the most reliable way for safe patient monitoring.**
- **The physiological data and alarm messages displayed on the equipment are for reference only and cannot be directly used as the basis for clinical treatment.**
- **To avoid inadvertent disconnection, route all cables in a way to prevent a stumbling hazard. Wrap and secure excess cabling to reduce risk of entanglement or strangulation by patients or personnel.**
- **Dispose of the package material, observing the applicable waste control regulations and keeping it out of children’s reach.**

1.1.3 Cautions

⚠ CAUTIONS

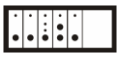
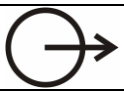
- **To ensure patient safety, use only parts and accessories specified in this manual.**
- **At the end of its service life, the equipment, as well as its accessories, must be disposed of in compliance with the guidelines regulating the disposal of such products. If you have any questions concerning disposal of the equipment, please contact us.**
- **Magnetic and electrical fields are capable of interfering with the proper performance of the equipment. For this reason make sure that all external devices operated in the vicinity of the equipment comply with the relevant EMC requirements. Mobile phone, X-ray equipment or MRI devices are a possible source of interference as they may emit higher levels of electromagnetic radiation.**
- **Before connecting the equipment to the power line, check that the voltage and frequency ratings of the power line are the same as those indicated on the equipment's label or in this manual.**
- **Always install or carry the equipment properly to avoid damage caused by drop, impact, strong vibration or other mechanical force.**

1.1.4 Notes

NOTES

- **Put the equipment in a location where you can easily see the screen and access the operating controls.**
- **Keep this manual in the vicinity of the equipment so that it can be obtained conveniently when needed.**
- **The software was developed in compliance with IEC60601-1-4. The possibility of hazards arising from software errors is minimized.**
- **This manual describes all features and options. Your equipment may not have all of them.**

1.2 Equipment Symbols

	Attention: Consult accompanying documents (this manual).		
	Power ON/OFF		Battery indicator
	Alternating current (AC)		Alarms paused
	System silenced		Record
	Freeze/unfreeze waveforms		Main menu
	NIBP start/stop key		Connector for satellite module rack
	Equipotential grounding		Video output
	USB connector		Network connector
	CIS connector		Auxiliary output connector
	Defibrillator connector		Zero key
	Check sensor		Calibrate key
	Measure/standby		Serial number
	Gas outlet		Manufacture date
	CE marking		
	European community representative		
	ESD warning symbol for electrostatic sensitive devices.		
	Type CF applied part. Defibrillator-proof protection against electric shock.		
	Type BF applied part. Defibrillator-proof protection against electric shock.		

	The following definition of the WEEE label applies to EU member states only. This symbol indicates that this product should not be treated as household waste. By ensuring that this product is disposed of correctly, you will help prevent bringing potential negative consequences to the environment and human health. For more detailed information with regard to returning and recycling this product, please consult the distributor from whom you purchased it. * For system products, this label may be attached to the main unit only.

1.3 Reference Literature

- Medical Device Directive 93/42/EEC
- IEC 60601-1:1988+A1:1991+A2:1995 or
  EN 60601-1:1990+A1:1993+A2:1995+A13:1996,
  Medical Electrical Equipment, Part 1: General Requirements for Safety
- EN60601-1-1 or IEC60601-1-1, Medical Electrical Equipment- Part 1-1: General Requirements for Safety - Collateral Standard: Safety Requirements for Medical Electrical Systems
- IEC60601-1-4, Medical Electrical Equipment- Part 1-4: General Requirements for Safety - Collateral Standard: Programmable Electrical Medical Systems
- IEC60601-2-49 Medical Electrical Equipment-Part 2-49: Particular Requirements for the Safety of Multifunction Patient Monitoring Equipment

FOR YOUR NOTES

2 The Basics

2.1 Monitor Description

2.1.1 Intended Use

This patient monitor is intended to be used for monitoring, displaying, reviewing, storing and transferring of multiple physiological parameters including ECG, heart rate (HR), respiration (Resp), temperature (Temp), SpO_2, pulse rate (PR), non-invasive blood pressure (NIBP), invasive blood pressure (IBP), cardiac output (C.O.), carbon dioxide (CO_2), oxygen (O_2), anesthetic gas (AG), impedance cardiograph (ICG), bispectral index (BIS) and respiration mechanics (RM) of single adult, pediatric and neonatal patients.

ST-segment monitoring and C.O. monitoring are restricted to adult patients only. The ICG is only for use on adult patients who meet the following requirements: height: 122 to 229 cm, weight: 30 to 159 kg. 12-lead ECG and BIS monitoring are not intended for neonatal patients.

This monitor is to be used in healthcare facilities by clinical professionals or under their direction. It is not intended for helicopter transport, hospital ambulance, or home use.

⚠ WARNING

- **This patient monitor is intended for use only by clinical professionals or under their guidance. It must only be used by persons who have received adequate training in its use. Anyone unauthorized or untrained must not perform any operation on it.**

2.1.2 Contraindications

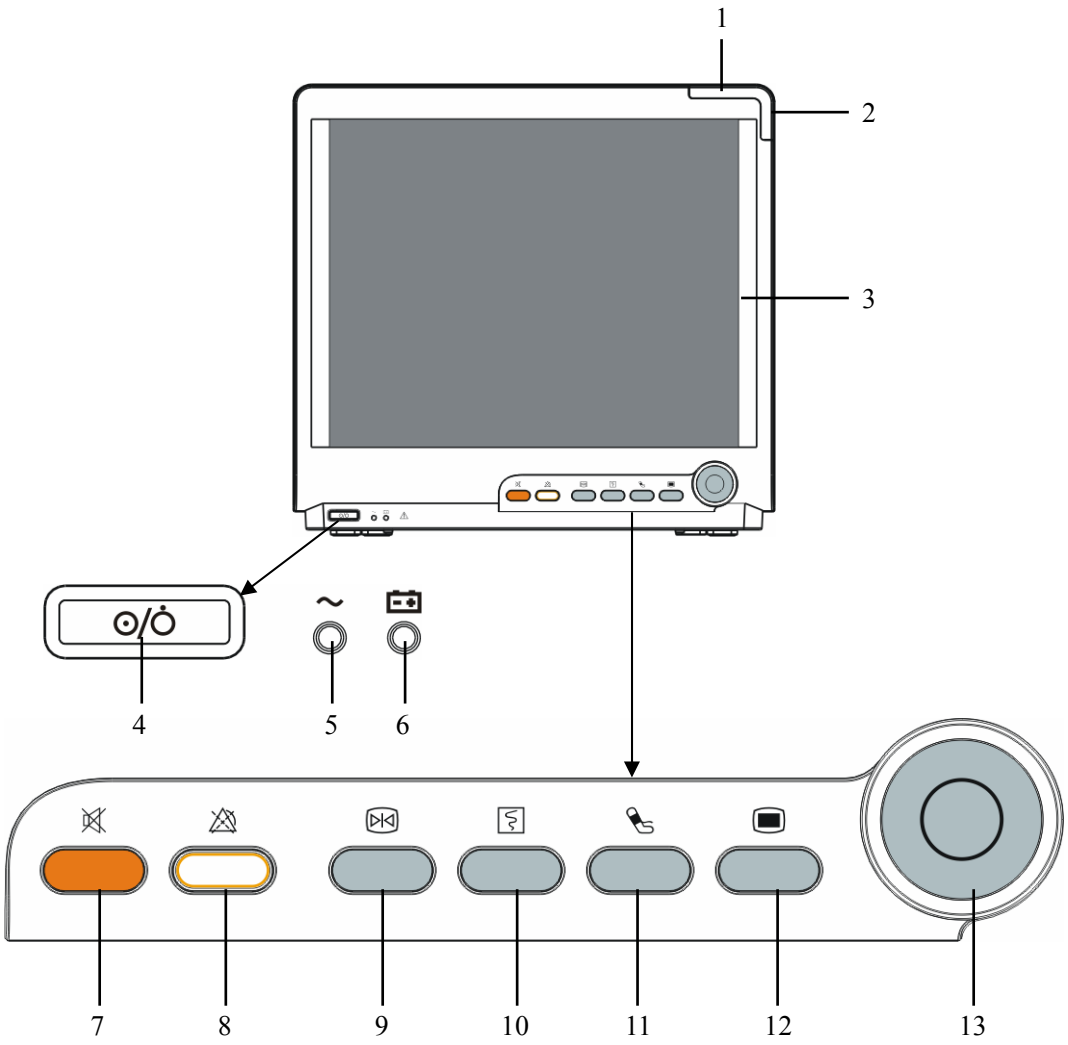
None.

2.1.3 Components

This patient monitor consists of a main unit, display, parameter module racks, SpO_2 sensor, NIBP cuff, IBP cables, C.O. cables, CO_2 components, AG components, RM components, BIS components, etc.

2.2 Main Unit

2.2.1 Front View



1. Physiological alarm lamp

   When a physiological alarm occurs, this lamp will flash as defined below.

   - High level alarms: the lamp quickly flashes red.
   - Medium level alarms: the lamp slowly flashes yellow.
   - Low level alarms: the lamp turns yellow without flashing.

2. Technical alarm lamp

   This lamp will turn blue when a technical alarm occurs.

3. Display Screen

4. Power On/Off Switch

   Press this switch to turn the patient monitor on. Press it again and hold for 2 seconds to turn the patient monitor off. An indicator is built in this switch. It turns on when the patient monitor is on and turns off when the patient monitor is off.

5. AC power LED

   It turns on when AC power is connected.

6. Battery LED

   - On: when the battery is being charged or already fully charged.
   - Off: when no battery is installed or no AC source is connected.
   - Flash: when the patient monitor operates on battery power.

7. Press to silence all system sounds.

8. Press to pause, restore or clear alarms.

9. Press to freeze or unfreeze waveforms.

10. Press to start or stop recordings.

11. Press to start or stop NIBP measurements.

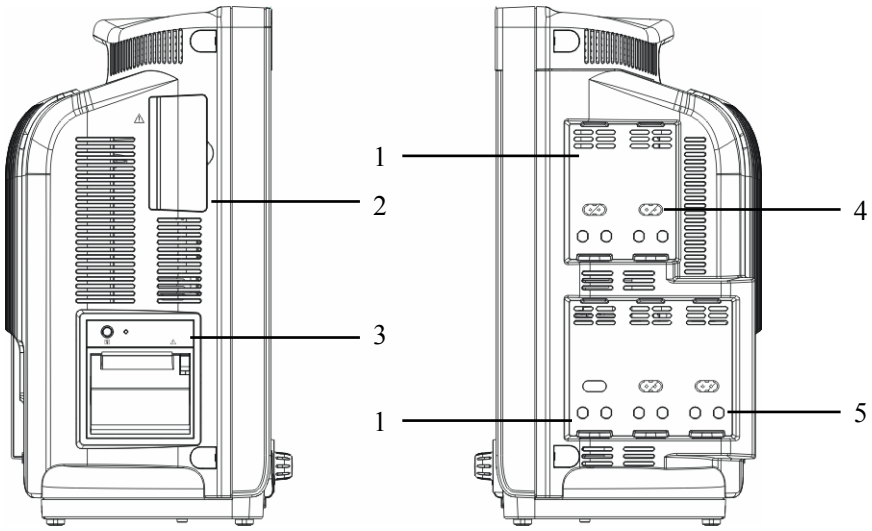
12. If no menu is displayed on the screen, pressing it will enter the main menu.
    If there is a menu displayed on the screen, pressing it will close that menu.

13. Knob

    As shown in the figure, you can:

    - Rotate the knob clockwise or anti-clockwise. With each click, the highlight jumps to the neighboring screen item, or
    - When you reach the desired screen item, press the knob to select the item.

2.2.2 Side View

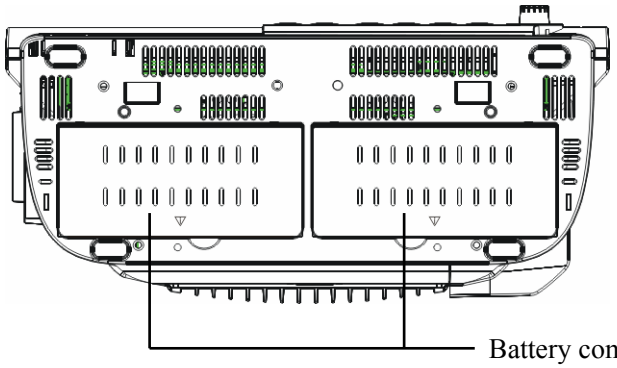


1. Integral Module Racks 2. Compartment for CF storage card slot
3. Recorder 4. Filter 5. Contact

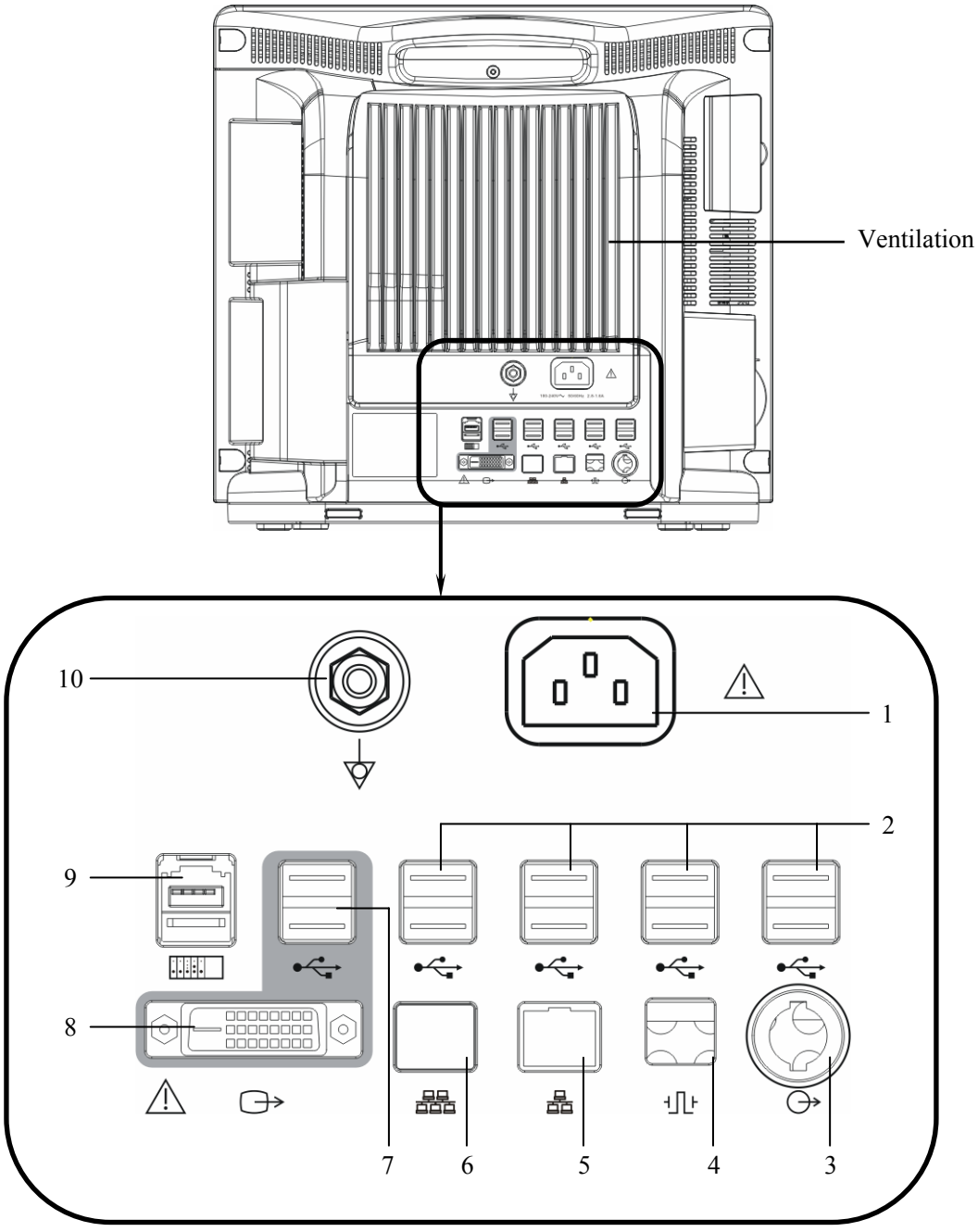
⚠ WARNING

- **Do not touch the filters and contacts when the patient monitor is on.**

2.2.3 Bottom View



2.2.4 Rear View



1. AC Power Input

2. USB Connectors

   They connect such devices as the USB mice, USB keyboard, etc.

3. Auxiliary Output Connector

   It provides analog signals if an oscilloscope is connected or alarm signals if a nurse call system is connected.

4. Defib Sync Connector

   It provides synchronization signals if a defibrillator is connected.

5. Network Connector

   It is a standard RJ45 connector that connects the patient monitor to the CMS.

6. CIS Connector

   It is a standard RJ45 connector that connects the patient monitor to the hospital's clinical information system (CIS). The CIS feature is available in China only.

7. USB Connectors

   They connect the controlling devices (USB mice and USB keyboard) of the secondary display.

8. Digital Video Interface (DVI)

   It connects a standard digital video display.

9. SMR Connector

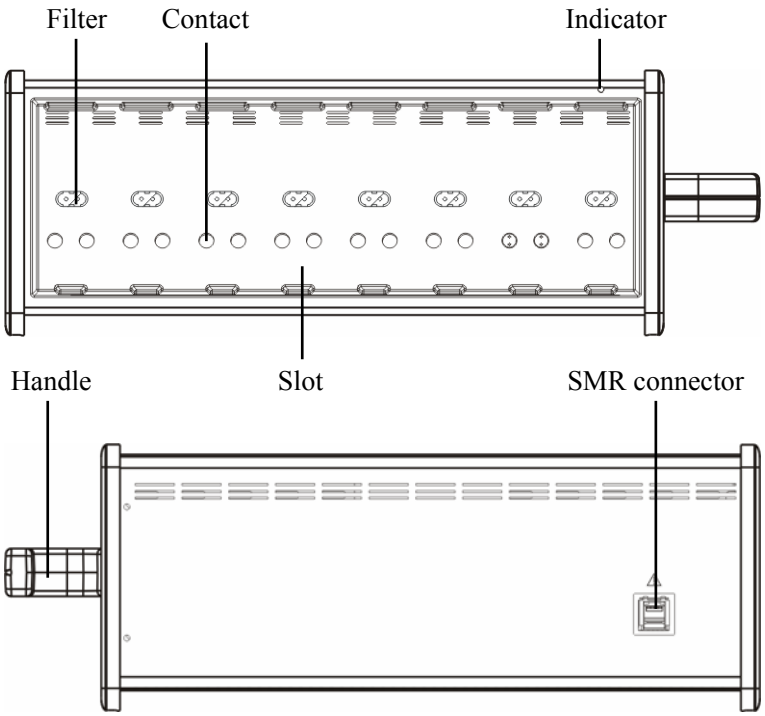
   It connects the satellite module rack (SMR).

10. Equipotential Grounding Terminal

    When the patient monitor and other devices are to be used together, their equipotential grounding terminals should be connected together, eliminating the potential difference between them.

2.3 Satellite Module Rack

The Satellite Module Rack (SMR) provides 8 slots for mounting parameter modules. The number of modules mounted in the SMR depends, as different modules may need different slots.



As shown in the figure above, there is an indicator telling the status of the SMR:

- On: when the SMR works normally.
- Off: when the SMR disconnects from the patient monitor, there is a problem with the power, or the patient monitor shuts down.

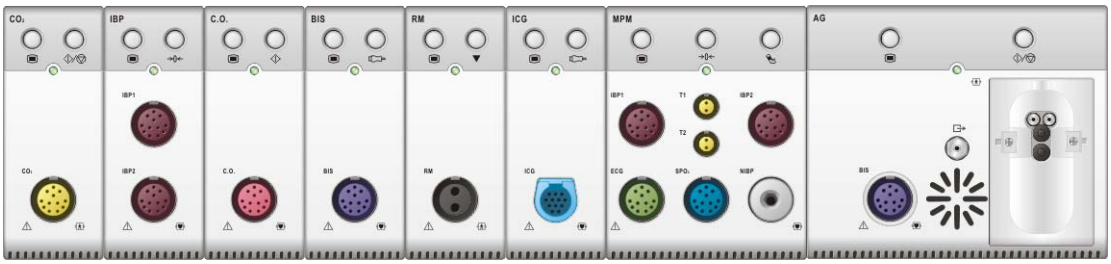
The SMR can be connected to the patient monitor through their SMR connectors via a SMR cable.

⚠ WARNING

- **Do not touch the filters and contacts when the patient monitor is on.**

2.4 Modules

As shown below, the patient monitor supports the following modules:



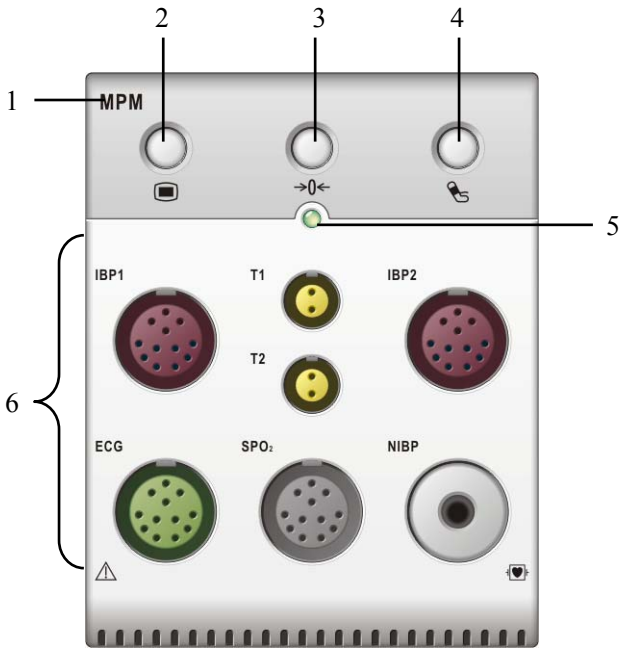
- MPM: Multi-parameter module. It can simultaneously monitor ECG, respiration, SpO_2, temperature, NIBP and IBP.
- IBP module: Invasive blood pressure module.
- C.O. module: Cardiac output module.
- CO_2 module: Carbon dioxide module.
- AG module: Anaesthesia gas module. The functions of the O_2 and BIS modules can be incorporated into it.
- ICG module: Impedance cardiography module.
- BIS module: Bispectral index module.
- RM module: Respiration mechanics module.

2.4.1 Plug-In Modules

You can plug and unplug modules during patient monitoring. To plug a module, insert the module until the lever on the module clicks into the place and then push the lock key at the bottom in position to lock the module. To remove a module, release the lock key, press the lever upwards and pull the module out.

2.4.2 Multi-Parameter Module

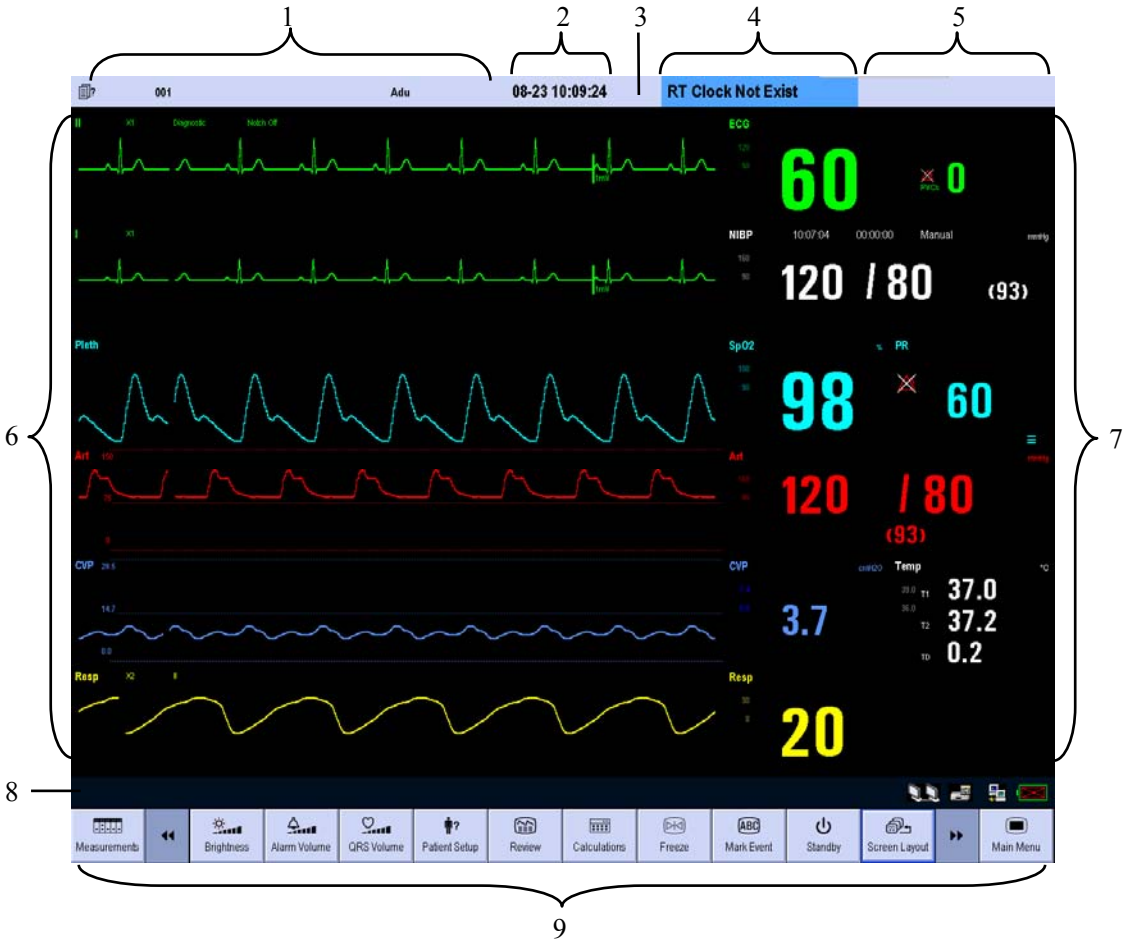
The multi-parameter module (MPM) incorporates multiple measurement modules. As shown below, the module name is located at the upper left corner, all hardkeys on the upper part, and all measurement connectors on the lower part. Other measurement modules look similar to the MPM.



1. Module name
2. Setup key: press to enter the [**MPM Setup**] menu.
3. Zero key: press to enter the [**Zero IBP**] menu.
4. NIBP start/stop key: press to start or stop NIBP measurements.
5. Indicator
   - ◆ On: when the patient monitor works correctly.
   - ◆ Flash: when the module is plugged into the patient monitor.
   - ◆ Off: when the module is either not in place or broken.
6. Measurement connectors

2.5 Display Screen

This patient monitor adopts a high-resolution TFT LCD to display patient parameters and waveforms. A typical display screen is shown below.



1. Patient Information Area

   This area shows the patient information such as department, bed number, patient name, patient category and paced status.

   - : indicates that no patient is admitted or the patient information is incomplete.
   - : indicates that the patient has a pacer.

   If no patient is admitted, selecting this area will enter the [**Patient Setup]** menu. If a patient has been admitted, selecting this area will enter the [**Patient Demographics]** menu.

2. Date and Time

   This area shows the system time of the patient monitor. By selecting this area, you can enter the [**System Time]** setup menu.

3. Sound Symbols

   - indicates alarms are paused.
   - indicates all system sounds are turned off.
   - indicates alarm sounds are turned off.

4. Technical Alarm Area

   This area shows technical alarm messages and prompt messages. When multiple messages come, they will be displayed circularly. Select this area, and the technical alarm list will be displayed.

5. Physiological Alarm Area

   This area shows physiological alarm messages. When multiple alarms occur, they will be displayed circularly. Select this area and the physiological alarm list will be displayed.

6. Waveform Area

   This area shows measurement waveforms. The waveform name is displayed at the left upper corner of the waveform. Select this area and the corresponding waveform setup menu will be displayed.

7. Parameter Area

   This area shows measurement parameters. Each monitored parameter has a parameter window and the parameter name is displayed at the upper left corner. When this area cannot accommodate all parameters, the excess parameters will automatically occupy the waveform area from bottom to top. Select this area and the corresponding measurement setup menu will be displayed.

8. Prompt Message Area

   This area shows the prompt messages telling the network status, battery status, etc. For details about battery status symbols, refer to the chapter ***23 Batteries***.

- indicates patient monitor is connected to a wire network successfully.
- indicates the patient monitor has failed to connect a wire network.
- indicates a CF storage card is inserted.
- indicates a secondary display is connected.

9. QuickKeys area

   This area contains QuickKeys that give you fast access to functions.

2.6 QuickKeys

A QuickKey is a configurable graphical key, located at the bottom of the main screen. They give you fast access to functions. Their availability, and the order in which they appear on your screen, depend on how you patient monitor is configured.

By default, the following QuickKeys are displayed on the screen:

Scroll left to display more QuickKeys.

Scroll right to display more QuickKeys.

Enter the measurement setup menu

Enter the main menu

Change screen brightness

Change alarm volume

Change QRS volume

Enter the patient setup menu

Review the patient's history data

Perform calculations

Freeze waveforms

Mark Event

Enter standby mode

Change screen

Start/stop NIBP measurements

Start NIBP STAT measurement

Zero IBP

Start cardiac output procedure

View respiratory loops

Enter the 12-lead analysis screen

Start/stop recordings

Print

Select parameter setup menu for the Big Numerics screen

Have a split-screen view of another patient's conditions

You can also select your desired QuickKeys to display on the screen.

1. Select [**Main Menu**]→[**Maintenance** >>]→[**User Maintenance** >>]→enter the required password→[**Select QuickKeys** >>].
2. In the [**Select QuickKeys**] menu, select your desired QuickKeys.
3. Select [**Ok**].

Besides the default QuickKeys listed above, there are still more QuickKeys:

Change alarm settings

Quickly admit a patient

Re-learn arrhythmia

Have a split-screen view of oxyCRG trends

Have a split-screen view of minitrends

Enter the user maintenance menu

Enter the analog output setup menu

Change key volume

Default configurations

Enter the full-screen 7-lead ECG screen

Switch on/off ST analysis

Calibrate the screen.

3 Basic Operations

3.1 Installation

⚠ WARNING

- **The equipment shall be installed by personnel authorized by us.**
- **The software copyright of the equipment is solely owned by us. No organization or individual shall resort to juggling, copying, or exchanging it or to any other infringement on it in any form or by any means without due permission.**
- **Devices connected to the equipment must meet the requirements of the applicable IEC standards (e.g. IEC 60950 safety standards for information technology equipment and IEC 60601-1 safety standards for medical electrical equipment). The system configuration must meet the requirements of the IEC 60601-1-1 medical electrical systems standard. Any personnel who connect devices to the equipment's signal input/output port is responsible for providing evidence that the safety certification of the devices has been performed in accordance to the IEC 60601-1-1. If you have any question, please contact us.**
- **If it is not evident from the equipment specifications whether a particular combination is hazardous, for example, due to summation of leakage currents, consult the manufacturers or else an expert in the field, to ensure the necessary safety of all devices concerned will not be impaired by the proposed combination.**

3.1.1 Unpacking and Checking

Before unpacking, examine the packing case carefully for signs of damage. If any damage is detected, contact the carrier or us.

If the packing case is intact, open the package and remove the equipment and accessories carefully. Check all materials against the packing list and check for any mechanical damage. Contact us in case of any problem.

NOTE

- **Save the packing case and packaging material as they can be used if the equipment must be reshipped.**

⚠ WARNING

- **When disposing of the packaging material, be sure to observe the applicable waste control regulations and keep it out of children's reach.**
- **The equipment might be contaminated during storage and transport. Before use, please verify whether the packages are intact, especially the packages of single use accessories. In case of any damage, do not apply it to patients.**

3.1.2 Environmental Requirements

The operating environment of the patient monitor must meet the requirements specified in this manual.

The environment where the patient monitor is used shall be reasonably free from noises, vibration, dust, corrosive, flammable and explosive substances. If the patient monitor is installed in a cabinet, sufficient space in front and behind shall be left for convenient operation, maintenance and repair. Moreover, to maintain good ventilation, the patient monitor shall be at least 2 inches (5cm) away from around the cabinet.

When the patient monitor is moved from one place to another, condensation may occur as a result of temperature or humidity difference. In this case, never start the system before the condensation disappears.

⚠ WARNING

- **Make sure that the operating environment of the patient monitor meets the specific requirements. Otherwise unexpected consequences, e.g. damage to the equipment, could result.**

3.2 Getting Started

3.2.1 Turning Power On

Once the patient monitor is installed, you can get ready for monitoring:

1. Before you start to make measurements, check the patient monitor, SMR and plug-in modules for any mechanical damage and make sure that all external cables, plug-ins and accessories are properly connected.
2. Plug the power cord into the AC power source. If you run the patient monitor on battery power, use two batteries and ensure that the batteries are sufficiently charged.
3. Press the power on/off switch on the monitor's front. The technical and physiological alarm lamps respectively flash blue and red once simultaneously, and the system gives a beep as well.
4. The monitor shows the product name and then enters the main screen.

⚠ WARNING

- **Do not use the patient monitor for any monitoring procedure on a patient if you suspect it is not working properly, or if it is mechanically damaged. Contact your service personnel or us.**

3.2.2 Starting Monitoring

1. Decide which measurements you want to make.
2. Connect the required modules, patient cables and sensors.
3. Check that the patient cables and sensors are correctly connected.
4. Check that the patient settings such as [**Patient Cat.**], [**Paced**], etc, are appropriate for your patient.
5. Refer to the appropriate measurement section for details of how to perform the measurements you require.

3.3 Disconnecting from Power

To disconnect the patient monitor from the AC power source, follow this procedure:

1. Confirm that the patient monitoring is finished.
2. Disconnect the patient cables and sensors from the patient monitor.
3. Make sure to save or clear the patient monitoring data as required.
4. Press and hold the power on/off switch for above 2 seconds. The patient monitor shuts down and you can unplug the power cable. If the patient monitor does not shut down properly, press and hold the power on/off switch for 4 seconds to shut it down.

⚠ CAUTION

- **It is not recommended to shut the patient monitor down by pressing the power on/off switch for 4 seconds, as this may cause damage to the patient monitor.**

3.4 Using a Mice

You can use the USB mice supplied with the equipment as a monitor input device. The USB mice can be plugged and unplugged with the monitor on.

The patient monitor supports two USB mice. One is for controlling the secondary display and must be connected to a dedicated connector, and the other for controlling the primary display and can be connected to any USB connector other than that dedicated one.

When you are using a mice:

- By default, the left mice-button is the primary button and the right one the secondary button.
- Clicking the primary button equals to pressing the knob or selecting the touchscreen.
- The secondary button is disabled.

You can also define the right mice button as the primary button by following this procedure:

1. Select [**Main Menu**]→[**Maintenance** >>]→[**User Maintenance** >>]→enter the required password.
2. Select [**Others** >>] to enter the [**Others**] menu.
3. Select [**Primary Button**] and then select [**Right**] from the popup list.

3.5 Using Keyboards

The on-screen keyboard enables you to enter information. Use the [**Back**] key to delete the previously entered character. Use the [**Caps**] to toggle between uppercase and lowercase letters. Select [**Enter**] to confirm what you have entered and close the on-screen keyboard.

If a conventional keyboard is connected to the monitor, you can use it instead of or in combination with the on-screen keyboard. The patient monitor supports two external keyboards. One is for controlling the secondary display and must be connected to a dedicated USB connector, and the other for controlling the primary display and can be connected to any USB connector other than that dedicated one.

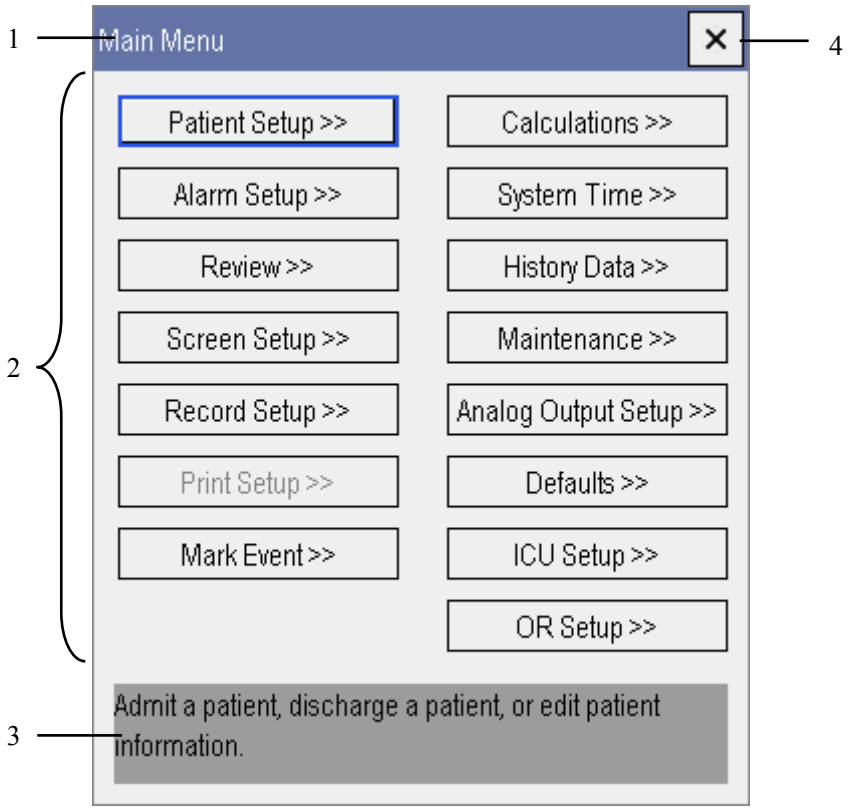
3.6 Using the Touchscreen

Select screen items by pressing them directly on the patient monitor's screen.

You can enable or disable touchscreen operation by pressing and holding the [**Measurements]** QuickKey for 3 seconds. A padlock symbol is displayed if if touchscreen operation is disabled.

3.7 Using the Main Menu

To enter the main menu, select the on-screen QuickKey or the hardkey on the monitor's front. Most of monitor operations and settings can be performed through the main menu.



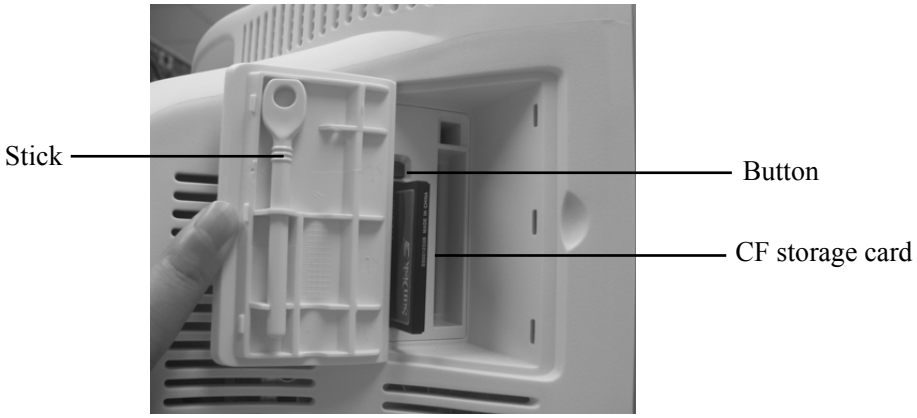
Other menus are similar to the main menu and contain the following parts:

1. Heading: gives a sum-up for the current menu.
2. Main body: displays options, buttons, prompt messages, etc. The menu button with ">>'' enlarges a secondary window to reveal more options or information.
3. Online help area: displays help information for the screen item to which the cursor points.
4. ✕: select to exit the current menu.

3.8 Using a CF Storage Card

A CF storage card is used to prevent data loss in case of a sudden power failure. The patient data such as trend data, waveform data, etc., will be automatically saved into the CF storage card during patient monitoring. In case of a sudden power failure, the patient data can be retrieved from the CF storage card after the patient monitor restarts.

Switching the patient monitor off before inserting or removing a CF card is a must. To insert a CF storage card, open the compartment on the left side and then insert the card until the button flips out. To remove the CF storage card, take the stick and use it to press the button until the CF storage card flips out.



To browse the data saved in the CF storage card, follow this procedure:

1. Select [**Main Menu**]→[**History Data >>**].
2. Select a patient whose data you want to view from the [**Patient Data List**] and then select [**Review**].
3. In the [**Review**] menu, select the data you want to review.

As reviewing the history patient's data is just like reviewing the current patient's data, you can refer to the chapter ***19 Review*** for details

NOTE

- **Data may be unable to be saved into the CF storage card when the patient monitor is just turned on.**

⚠ CAUTION

- **To avoid electrostatics, do not come into contact with the CF storage card when the patient monitor is on.**

- **Do not insert or remove the CF storage card when the patient monitor is on. Otherwise it may cause damage to the CF storage card and the patient monitor.**
- **Never apply the CF storage card to those other than the patient monitor.**

3.9 Changing General Settings

This chapter covers only general settings such as language, brightness, date and time, etc. Measurement settings and other settings can be referred to in respective sections.

3.9.1 Setting up a Monitor

In situations where you install a patient monitor or change the patient monitor's application site, you need to setup the patient monitor as follows:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. In the [**User Maintenance**] menu, select, in turn, [**Monitor Name**], [**Department**] and [**Bed No.**], and then change their settings.

3.9.2 Changing Language

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. In the [**User Maintenance**] menu, select [**Language**] and then select the desired language.
3. Restart the patient monitor.

3.9.3 Adjusting the Screen Brightness

1. Select the [**Brightness**] QuickKey, or [**Main Menu**]→[**Screen Setup >>**]→ [**Brightness**].
2. Select the appropriate setting for the screen brightness. 10 is the brightest, and 1 is the least bright.

If the patient monitor operates on battery power, you can set a less bright screen to prolong

the use time of the battery. When the patient monitor enters standby mode, the screen brightness will be adjusted to the least bright automatically.

3.9.4 Showing/Hiding the Help

The patient monitor provides online help information. The user can display or hide the help as required.

1. Select [**Main Menu**]→[**Screen Setup** >>].
2. Select [**Help**] and toggle between [**On**] and [**Off**].

3.9.5 Setting the Date and Time

1. Select [**Main Menu**]→[**System Time** >>].
2. Set the date and time.
3. Select [**Date Format**] and toggle between [**yyyy-mm-dd**], [**mm-dd-yyyy**] and [**dd-mm-yyyy**].
4. Select [**Time Format**] and toggle between [**24h**] and [**12h**].

If your patient monitor is connected to a central monitoring system (CMS), the date and time are automatically taken from that CMS. In that case, you cannot change the date and time settings on your patient monitor.

⚠ CAUTION

- **Changing date and time will affect the storage of trends and events and may cause data missing.**

3.9.6 Adjusting Volume

Alarm Volume

1. Select the [**Alarm Volume**] QuickKey, or [**Main Menu**]→[**Alarm Setup** >>].
2. Select [**Alarm Volume**] and then select the appropriate volume. 1 is the minimum volume, and 10 is the maximum volume.

Key Volume

1. Select the [**Key Volume**] QuickKey, or [**Main Menu**]→[**Screen Setu**p >>].
2. Select [**Key Volume**] and then select the appropriate volume. 0 means off, and 10 is the maximum volume.

QRS Volume

The QRS tone is derived from either the HR or PR, depending on which is currently selected as the alarm source in [**ECG Setup**] or [**PR Setup**]. When monitoring SpO_2, there is a variable pitch tone which changes as the patient's saturation level changes. The pitch of the tone rises as the saturation level increases and falls as the saturation level decreases. The volume of this tone is user adjustable.

1. Select the [**QRS Volume**] QuickKey, or the ECG or SpO_2 parameter window→[**PR Setup** >>].

2. Select [**Beat Vol**] and then select the appropriate volume. 0 means off, and 10 is the maximum volume.

3.10 Default Configurations

NOTE

- **When the patient monitor restarts after a power failure, all settings before the power failure will be automatically restored.**

3.10.1 Restoring the Factory Default Configuration

To restore the factory default configuration, follow this procedure:

1. Select [**Main Menu]**→[**Defaults>>**].
2. Select the factory default configuration which is currently available depending on the current patient's category.
3. Select [**Yes**] in the popup menu.
4. Verify if the selected configuration is appropriate. Change some settings if necessary.

3.10.2 Saving Current Configuration as User Default Configuration

You can modify the factory default values from the factory default configuration and then save the modified configuration as a user default configuration. The patient monitor can save multiple user default configurations, and you can name the saved user default configurations.

1. Modify the factory default values as required and make sure that the modifications are appropriate for your patient.
2. Select [**Main Menu**]→[**Defaults** >>]→[**Save as User Default Config** >>].
3. Enter a name in the popup menu.
4. Select [**Save**].
5. If the entered name already exists, a message box will be displayed. Follow the instruction given in that message box.

The configuration name saved in the patient monitor is in the form of “entered name+patient category+Config”. e.g., if you enter the name “ICU1” and the current patient is an adult, the configuration name will be “ICU1 Adult Config”.

3.10.3 Loading a User Default Configuration

You can directly recall an already saved user default configuration.

1. Select [**Main Menu**]→[**Defaults >>**]→[**Load User Default Config >>**].
2. Select a user default configuration you want to apply and then select [**Ok**].
3. Select [**Yes**] from the popup menu.
4. Make sure the configuration is appropriate. Change some values if necessary.

3.10.4 Deleting a User Default Configuration

You can delete an already saved user default configuration.

1. Select [**Main Menu**]→[**Defaults** >>]→[**Delete User Default Config** >>].
2. Select the configuration(s) you want to delete, or select [**Select All**].
3. Select [**Delete**] and then select [**Yes**] from the popup menu.

4 Managing Patients

4.1 Admitting a Patient

The patient monitor displays physiological data and stores them in the trends as soon as a patient is connected. This allows you to monitor a patient that is not yet admitted. However, it is recommended that you fully admit a patient so that you can clearly identify your patient, on recordings, reports and networking devices.

To admit a patient:

1. Select the [**Patient Setup**] QuickKey, or [**Main Menu**]→[**Patient Setup >>**].
2. Select [**Discharge Patient**] to clear any previous patient data. If you do not erase data from the previous patient, the new patient's data will be saved into the data of the previous patient. The monitor makes no distinction between the old and the new patient data.
3. If [**Discharge Patient**] button appears dimmed, directly select [**Admit Patient**] and then select:
   - [**Yes**] to apply the data saved in the patient monitor to the new patient, or
   - [**No**] to clear the data saved in the patient monitor.
4. In the [**Patient Demographics**] menu, enter the demographic details, of which:
   - [**Patient Cat.**] determines the way your patient monitor processes and calculates some measurements, and what safety and alarm limits are applied for your patient.
   - [**Paced**] determines whether to show pace pulse marks on the ECG waveform. When the [**Paced**] is set to [**No**], pace pulse marks are not shown in the ECG waveform.
5. Select [**Ok**].

⚠WARNING

- **[Patient Cat.] and [Paced] will always contain a value, regardless of whether the patient is fully admitted or not. If you do not specify settings for these fields, the patient monitor uses the default settings from the current configuration, which might not be correct for your patient.**
- **For paced patients, you must set [Paced] to [Yes]. If it is incorrectly set to [No], the patient monitor could mistake a pace pulse for a QRS and fail to alarm when the ECG signal is too weak.**
- **For non-paced patients, you must set [Paced] to [No]. If it is incorrectly set to [Yes], the patient monitor may be unable to detect premature ventricular beats (including PVCs) and perform ST segment analysis.**

4.2 Quick Admitting a Patient

Use [**Quick Admit**] only if you do not have the time or information to fully admit a patient. Complete the rest of the patient demographic details later. Otherwise, the symbol will always be displayed in the patient information area.

1. Select the [**Patient Setup**] QuickKey, or [**Main Menu**]→[**Patient Setup >>**].
2. Select [**Discharge Patient**] to clear any previous patient data. If you do not erase data from the previous patient, the new patient's data will be saved into the data of the previous patient. The monitor makes no distinction between the old and the new patient data.
3. If [**Discharge Patient**] button appears dimmed, directly select [**Admit Patient**] and then select:
   - [**Yes**] to apply the data in your patient monitor to the new patient, or
   - [**No**] to clear any previous patient data**.**
4. Enter the patient category and paced status for the new patient, and then select [**Ok**].

4.3 Editing Patient Information

To edit the patient information after a patient has been admitted, or when the patient information is incomplete, or when you want to change the patient information:

1. Select the [**Patient Setup**] QuickKey, or [**Main Menu**]→[**Patient Setup >>**].
2. Select [**Patient Demographics**] and then make the required changes.
3. Select [**Ok**].

4.4 Discharging a Patient

To discharge a patient:

1. Select the [**Patient Setup**] QuickKey, or [**Main Menu**]→[**Patient Setup >>**].
2. Select [**Discharge Patient**]. In the popup menu, you can either:
   - Directly select [**Ok**] to discharge the current patient, or
   - Select [**Standby**] then [**Ok**]. The patient monitor enters the standby mode after discharging the current patient, or
   - Select [**Cancel**] to exit without discharging the patient.

4.5 Connecting to a Central Monitoring System

If your patient monitor is connected to a central monitoring system (CMS):

- All patient information, measurement data and settings on the patient monitor can be transferred to the CMS.
- All patient information, measurement data and settings can be displayed simultaneously on the patient monitor and CMS. For some functions such as editing patient information, admitting a patient, discharging a patient, starting/stopping NIBP measurements, etc., bi-directional control can be achieved between your patient monitor and the CMS.

For details, refer to the CMS's instructions for use.

5 User Screens

5.1 Tailoring Your Screens

You can tailor your patient monitor's screens by setting:

- Waveform sweep mode
- Wave line size
- The color in which each measurement's numerics and waveform are displayed
- The parameter to be monitored.

Changing some settings may be hazardous. Therefore, those setting are password-protected and can be modified by authorized personnel only. Once change is made, those who use the patient monitor should be notified.

5.1.1 Setting the Waveform Sweep Mode

1. Select [**Main Menu**]→[**Screen Setup** >>].
2. Select [**Sweep Mode**] and toggle between [**Refresh**] and [**Scroll**].
   - [**Refresh**]: The waveforms keep stationary, with real-time refreshing from left to right by a moving "erase bar".
   - [**Scroll**]: The waveforms move from the right to the left with time passing by.

5.1.2 Changing the Wave Line Size

1. Select [**Main Menu**]→[**Maintenance** >>]→[**User Maintenance** >>]→enter the required password.
2. Select [**Others** >>].
3. Select [**Wave Line**] and toggle between [**Thick**], [**Mediate**] and [**Thin**].

5.1.3 Changing Measurement Colors

1. Select [**Main Menu**]→[**Screen Setup** >>]→[**Measurement Color Setup** >>].
2. Select the color box next to your desired measurement and then select a color from the popup menu.

5.1.4 Selecting Measurement Parameters

Your can select your desired measurement parameters for monitoring by following this procedure:

1. Select the [**Measurements**] QuickKey.
2. Select the required parameters from the popup menu.
3. Close the popup menu, and your selections will be automatically applied.

Additionally, you can close a waveform or turn off a measurement. To close a waveform, select your desired waveform and then select [Close Wave] from the popup menu. To turn off a measurement, select your desired measurement parameter window, for example, the ECG parameter window, and then select [Stop ECG] from the popup menu.

5.1.5 Substituting or Adding a Wave

You can substitute individual waves or add a wave to display.

To substitute individual waveforms:

1. Select the wave segment (e.g. wave A) on the monitor where you want a new wave to appear. This calls up a popup menu.
2. Select [**Change Wave**] and then select a wave (e.g. wave B) you want. The wave A is substituted by the wave B. If the wave B is displayed on the screen before you make the change, the wave A will be automatically displayed in its original position.

To add a new wave for display:

1. Select the wave segment on the monitor below which you want to add a new wave. This calls up a popup menu.
2. Select [**Add Wave**] and then select a wave you want. Your selection will automatically take effect as soon as the popup menu is closed.

5.1.6 Changing Screen Layout

1. Select the [**Screen Layout**] QuickKey, or [**Main Menu**]→[**Screen Setup >>**]→ [**Screen Layout >>**].
2. Select a normal screen. “Factory default” means that the parameters are displayed in a pre-defined order and the order cannot be changed by the user.
3. You can also select a split-screen functional view if necessary. But the functional view is not available with the big numerics screen.

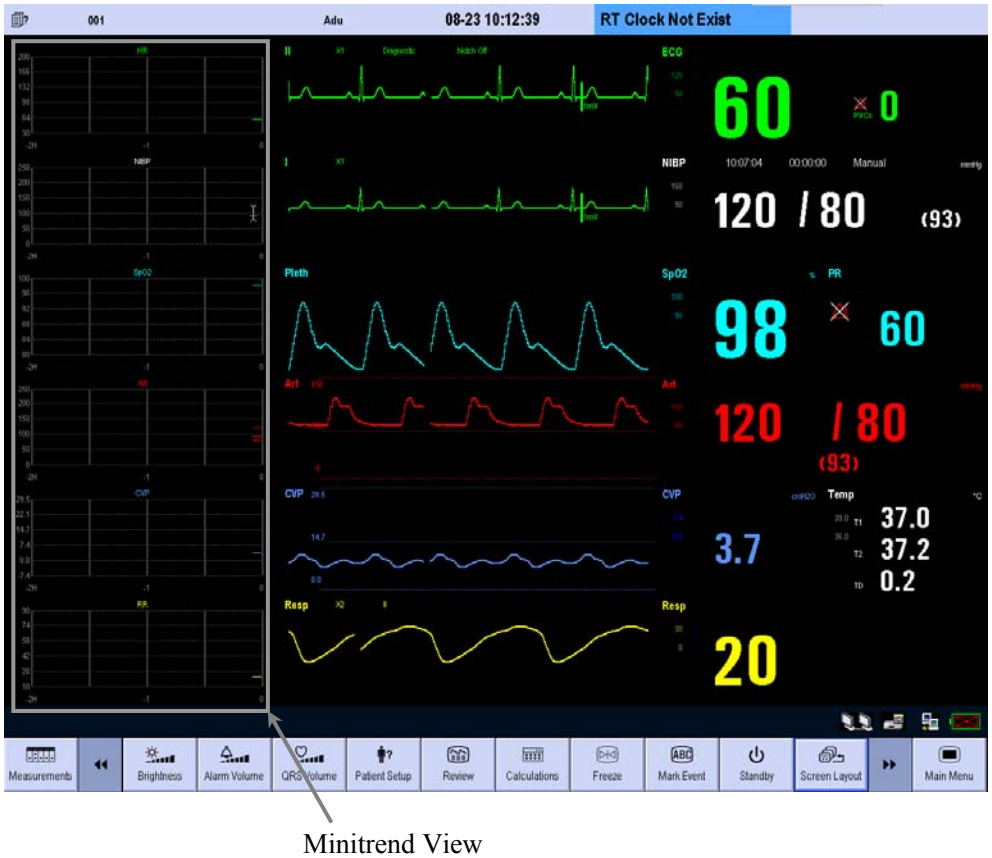
5.2 Viewing Minitrends

5.2.1 Having a Split-Screen View of Minitrends

You can split the normal screen so that one part of the screen, on the left hand side, continuously shows graphic minitrends beside waveforms as shown in the figure below.

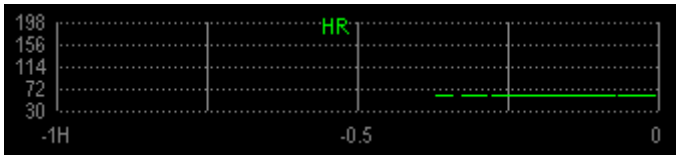
To have a split-screen view of minitrends, you can:

- Select [**Minitrends**] QuickKey, or
- Select [**Screen Layout**] QuickKey→[**Minitrends**]→[**Ok**], or
- Select [**Main Menu**]→[**Screen Setup** >>]→[**Screen Layout** >>]→[**Minitrends**]→[**Ok**].



Minitrend View

The split-screen view provides minitrends for multiple parameters. In each field, the label, scale and time are respectively displayed at the top, left, and bottom as shown below.



5.2.2 Changing Minitrend Length

You can change the minitrend length for individual parameters. Take HR for example:

1. Select the HR field.
2. In the [**Minitrend Setup**] menu, select [**Minitrend Length**] and then choose [**1 h**], [**2 h**], [**4 h**] or [**8 h**].
3. Select the ✕ button.

5.2.3 Changing a Parameter for Viewing

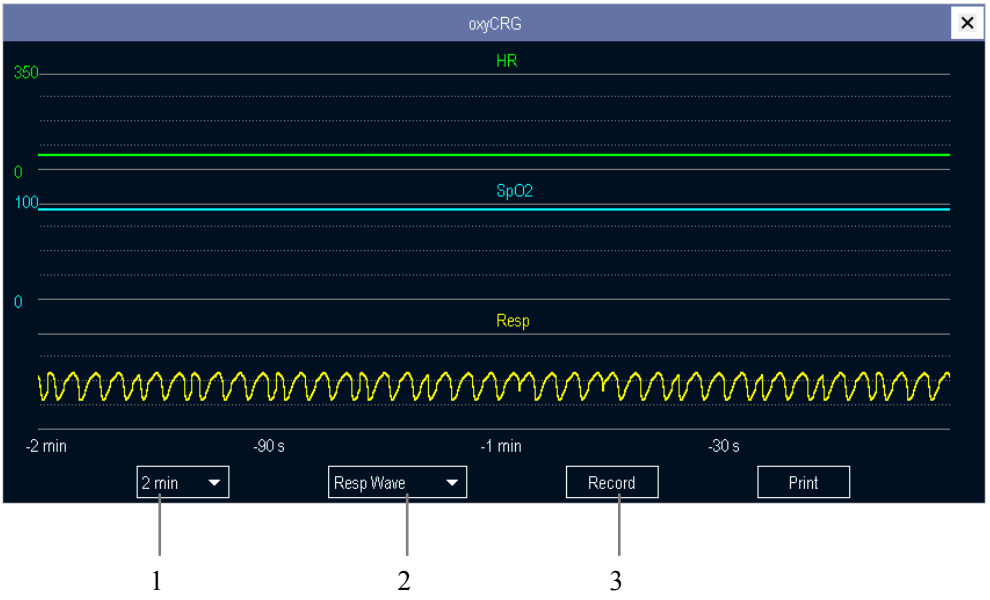
In each field, you can change a parameter to view its minitrends. Take HR for example:

1. Select the HR field.
2. In the [**Minitrend Setup**] menu, select [**PVCs**], or [**Other Parameters** >>] and then select the desired parameter.
3. Select the ✕ button.

5.3 Viewing oxyCRG

To have a split screen view of oxyCRG, you can:

- Select [**oxyCRG**] QuickKey, or
- Select [**Screen Layout**] QuickKey→[**oxyCRG**]→[**Ok**], or.
- Select [**Main Menu**]→[**Screen Setup** >>]→[**Screen Layout** >>]→[**oxyCRG**]→[**Ok**].



The split-screen view covers the lower part of the waveform area and shows HR trend, SpO_2 trend and RR trend (or Resp wave). At the bottom, there are three controls:

- Trend length list box

  In the trend length list box, you can select [**1 min**], [**2 min**], [**4 min**], or [**8 min**].

- Resp Wave (or RR Trend) list box

  From this list box, you can select either [**Resp Wave**] or [**RR Trend**] for display.

- Record

  Through this button, you can print out the currently displayed oxyCRG trends by the recorder.

5.4 Viewing Other Patients

5.4.1 Care Group

If your patient monitor is connected to a central monitoring system, you can select up to 16 bedside monitors into a Care Group. This lets you:

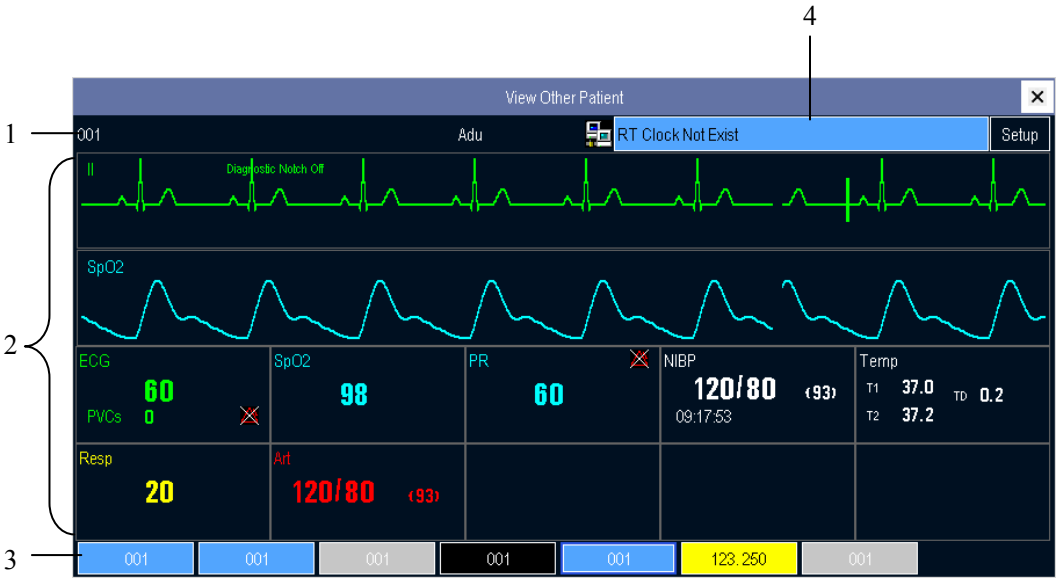
- View information on the monitor screen from other bed in the same.
- Be notified of physiological and technical alarm conditions of other beds in the Care Group.

To have a Care Group:

1. Open the [**View Other Patient**] window by:
   - Selecting [**Other Patients**] QuickKey, or
   - Selecting [**Screen Layout**] QuickKey→[**Other Patients**]→[**Ok**], or
   - Selecting [**Main Menu**]→[**Screen Setup** >>]→[**Screen Layout** >>]→[**Other Patients**]→[**Ok**].
2. Select [**Setup**] in the [**View Other Patient**] window.
3. Select the desired bedside monitors from the [**Connected Monitor List**], and then select the ✕ button. The selected bedside monitors constitute a Care Group.

5.4.2 Understanding the View Other Patient Window

The first time you open the [**View Other Patient**] window, the patient monitor automatically selects a monitor from the network to display in the [**View Other Patient**] window.



The [**View Other Patient**] window covers the lower part of the waveform area and consists of:

1. Information Area: shows the patient information (including department, bed number, patient name, etc.), network status symbol, physiological/technical alarm messages.
2. View Area: shows physiological waveforms and parameters. This area contains four areas, two waveforms areas and two parameter areas. You can switch a waveform area to a parameter area by selecting your desired waveform area and then selecting [**Switch to Parameter Area**], or switch a parameter area to a waveform area by selecting your desired parameter area and then selecting [**Switch to Waveform Area**].
3. Care Group: shows the bedside monitors you select for viewing through the [**View Other Patient**] window. The color a bedside monitor appears in matches its status:
   - Red: indicates the patient monitor is giving high-level physiological alarms.
   - Yellow: indicates the patient monitor is giving medium- or low-level physiological alarms.
   - Blue: indicates the patient monitor is giving technical alarms.
   - Grey: indicates the patient monitor fails to be networked or stays in the standby mode.

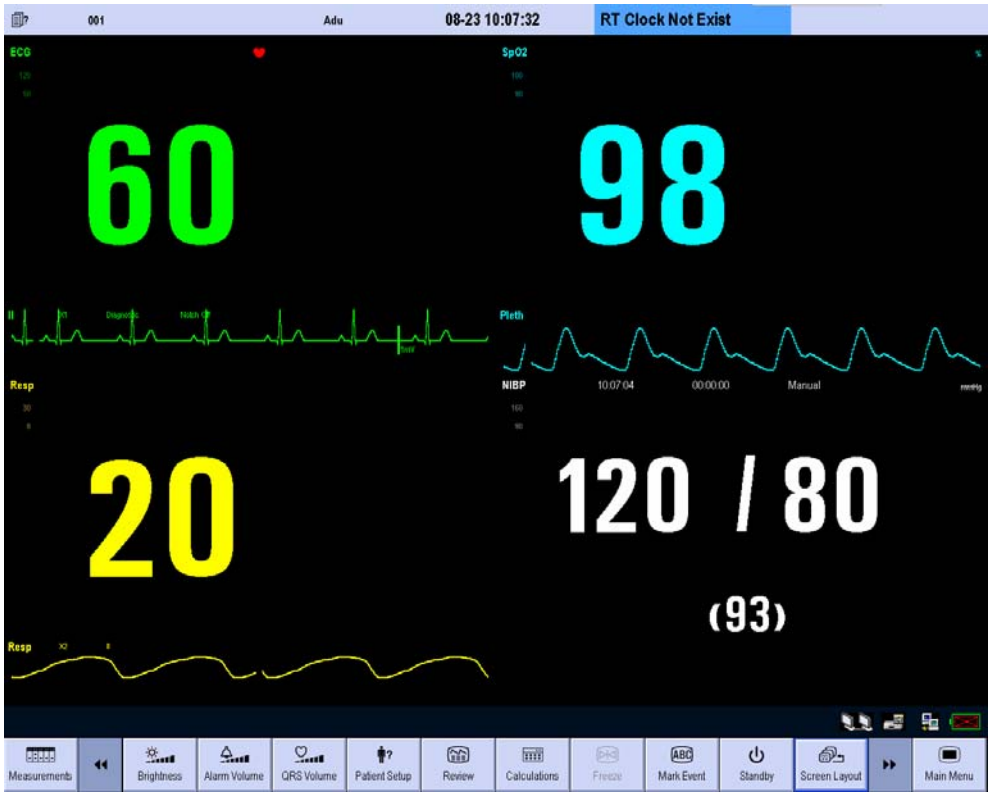
   You can view a patient monitor's alarms by selecting it from the care group, and furthermore, you can select the [**View This Patient**] button to view this patient monitor in the [**View Other Patient**] window.
4. Message Area: shows physiological, technical and prompt messages from the currently viewed patient monitor. By selecting this area, you can enter the [**Alarm Information List**].

Additionally, you can change a waveform or parameter for viewing. To change a waveform for viewing, select the waveform segment where you want a new waveform to appear and then select the waveform you want from the popup menu. To change a parameter for viewing, select the parameter window where you want a new parameter to appear and then select the parameter you want from the popup menu.

5.5 Understanding the Big Numerics Screen

To enter the big numerics screen:

1. Select the [**Screen Layout**] QuickKey, or [**Main Menu**]→[**Screen Setup** >>]→[**Screen Layout** >>].
2. Select [**Big Numerics**] or [**Factory Default Big Numerics**]→[**Ok**].



You can select your desired parameters to display in this screen: select the [**Para. Setup**] QuickKey and then select the parameters you want. For parameters having a waveform, the waveform will also be displayed.

6 Alarms

Alarms, triggered by a vital sign that appears abnormal or by technical problems of the patient monitor, are indicated to the user by visual and audible alarm indications.

6.1 Alarm Categories

By nature, the patient monitor's alarms can be classified into three categories: physiological alarms, technical alarms and prompt messages.

1. Physiological alarms

   Physiological alarms, also called patient status alarms, are triggered by a monitored parameter value that violates set alarm limits or an abnormal patient condition. Physiological alarm messages are displayed in the physiological alarm area.

2. Technical alarms

   Technical alarms, also called system status alarms, are triggered by a device malfunction or a patient data distortion due to proper operation or mechanical problems. Technical alarm messages are displayed in the technical alarm area.

3. Prompt messages

   As a matter of fact, prompt messages are not alarm messages. Apart from the physiological and technical alarm messages, the patient monitor will show some messages telling the system status. Messages of this kind are included into the prompt message category and usually displayed in the prompt information area. But for some measurements, their related prompt messages are displayed in their respective parameter windows.

6.2 Alarm Levels

By severity, the patient monitor's alarms can be classified into three categories: high level alarms, medium level alarms and low level alarms.

1. High level alarms

   Indicate that your patient is in a life threatening situation and an emergency treatment is demanded.

2. Medium level alarms

   Indicate that your patient's vital signs appear abnormal and an immediate treatment is required.

3. Low level alarms

   Indicate that you patient's vital signs appear abnormal and an immediate treatment may be required.

All technical alarms are low level alarms. The level for all technical alarms and some physiological alarms are predefined before the patient monitor leaves the factory and cannot be changed. But for some physiological alarms, the level is user adjustable.

6.3 Alarm Indicators

When an alarm occurs, the patient monitor will indicate it to the user through visual or audible alarm indications.

- Alarm lamp
- Alarm message
- Flashing numeric
- Audible alarm tones

6.3.1 Alarm Lamp

If a technical alarm occurs, the technical alarm lamp will turn blue. If a physiological alarm occurs, the physiological alarm lamp will flash. The flashing color and frequency match the alarm level as follows:

- High level alarms: the lamp quickly flashes red.
- Medium level alarms: the lamp slowly flashes yellow.
- Low level alarms: the lamp turns yellow without flashing.

6.3.2 Alarm Message

When an alarm occurs, an alarm message will appear in the technical or physiological alarm area. For physiological alarms, the asterisk symbols (*) before the alarm message match the alarm level as follows:

- High level alarms: ***
- Medium level alarms: **
- Low level alarms: *

Additionally, the alarm message uses different background color to match the alarm level:

- High level alarms: red
- Medium level alarms: yellow
- Low level alarms: yellow

For technical alarm messages, their background highlights in blue. When the technical alarm area shows prompt messages, the background keeps blank. You can view the alarm messages by selecting the physiological or technical alarm area.

6.3.3 Flashing Numeric

If an alarm triggered by an alarm limit violation occurs, the numeric of the measurement in alarm will flash every second, and the corresponding alarm limit will also flash at the same frequency indicating the high or low alarm limit is violated.

6.3.4 Audible Alarm Tones

The patient monitor uses different alarm tone patterns to match the alarm level:

- High level alarms: triple+double+triple+double beep.
- Medium level alarms: triple beep.
- Low level alarms: single beep.

NOTE

- **When multiple alarms of different levels occur simultaneously, the patient monitor will select the alarm of the highest level and give visual and audible alarm indications accordingly.**

6.3.5 Alarm Status Symbols

Apart from the aforementioned alarm indicators, the patient monitor still uses the following symbols telling the alarm status:

- indicates alarms are paused.
- indicates all system sounds are silenced.
- indicates the alarm sound is turned off.
- indicates individual measurement alarms are turned off.

6.4 Alarm Tone Configuration

6.4.1 Changing the Alarm Volume

1. Select the [**Alarm Setup**] QuickKey, or [**Main Menu**]→[**Alarm Setup** >>].
2. Select [**Alarm Volume**] and then select the appropriate volume. 1 is minimum volume, and 10 the maximum volume.

6.4.2 Switching the Alarm Sound On/Off

1. Select [**Main Menu**]→[**Maintenance** >>]→[**User Maintenance** >>]→enter the required password.
2. Select [**Alarm Setup** >>] to enter the [**Alarm Setup**] menu.
3. Select [**Alarm Sound**] and toggle between [**On**] and [**Off**].

6.4.3 Setting the Interval between Alarm Sounds

1. Select [**Main Menu**]→[**Maintenance** >>]→[**User Maintenance** >>]→enter the required password.
2. Select [**Alarm Setup** >>] to enter the [**Alarm Setup**] menu.
3. Select [**High Alarm Interval (s)**], [**Med Alarm Interval (s)**] and [**Low Alarm Interval (s)**] in turn and then select the appropriate settings.

⚠ WARNING

- **When the alarm sound is switched off, the patient monitor will give no audible alarm tones even if a new alarm occurs. Therefore the user should be very careful about whether to switch off the alarm sound or not.**
- **Do not rely exclusively on the audible alarm system for patient monitoring. Adjustment of alarm volume to a low level may result in a hazard to the patient. Always keep the patient under close surveillance.**

6.5 Using Alarms

6.5.1 Switching Individual Measurement Alarms On/Off

1. Select the parameter window for your desired measurement to enter its setup menu.
2. Select [**Alarm**] and toggle between [**On**] and [**Off**].
   - [**On**]: The patient monitor gives alarm indications in accordance with the preset alarm level and stores the related waveforms and parameters.
   - [**Off**]: The alarm off symbol " " is displayed in the measurement parameter window.

6.5.2 Setting the Alarm Level

1. Select the parameter window for your desired measurement to enter its setup menu.
2. Select [**Alm Lev**] and toggle between [**High**], [**Med**] and [**Low**].

6.5.3 Adjusting Alarm Limits

To adjust alarm limits for individual measurements:

1. Select the parameter window for your desired measurement to enter its setup menu.
2. In the setup menu, select the alarm limit you want to change and then select the appropriate settings.

6.5.4 Recording Alarms Automatically

When a measurement alarm occurs, automatic recording of all the measurement numerics and related waveforms is possible when the measurement's [**Alarm**] and [**Alm Rec**] are set on.

To switch automatic start of alarm recording on or off for individual measurements, you can either:

1. In the setup menu for your desired measurement, select [**Alm Rec**] and toggle between [**On**] and [**Off**], or
2. Select [**Main Menu**]→[**Alarm Setup >>**]→[**Alarm Recordings >>**]. In the [**Alarm Recordings**] menu, select your desired measurement and toggle between [**On**] and [**Off**].

Additionally, you can change the length of the recorded waveforms. In the [**Alarm Setup**] menu, select [**Recording Length**] and toggle between [**8 s**], [**16 s**] and [**32 s**]:

- [**8 s**]: 4 seconds respectively before and after the alarm trigger moment.
- [**16 s**]: 8 seconds respectively before and after the alarm trigger moment.
- [**32 s**]: 16 seconds respectively before and after the alarm trigger moment.

6.6 Pausing Alarms

If you want to temporarily prevent alarms from sounding, you can pause alarms by pressing the hardkey on the monitor's front. When alarms are paused:

- No alarm lamps flash and no alarms are sounded.
- No numeric and alarm limit flash.
- No alarm messages are shown.
- The remaining pause time is displayed in the physiological alarm area.
- The alarms paused symbol is displayed in the sound symbol area.

When the alarm pause time expires or a new technical alarm occurs, the alarm paused status is automatically cancelled and the alarm tone will sound. You can also cancel the alarm paused status by pressing the hardkey.

You can set the alarm pause time as desired. The default alarm pause time is 2 minutes.

1. Select [**Main Menu**]→[**Maintenance** >>]→[**User Maintenance** >>]→enter the required password.
2. Select [**Alarm Setup** >>]→[**Alarm Pause Time**] and then select the appropriate setting from the popup list.

6.7 Silencing the System

You can silence all system sounds by pressing the hardkey on the monitor's front. In that case, will be displayed in the sound symbol area indicating all system sounds are silenced. During system silence time, all alarm indicators except audible alarm tones behave correctly. You can press the hardkey again to cancel the system silenced status. When a new alarm occurs, the system silenced status will be automatically cancelled.

6.8 Latching Alarms

The alarm latching setting for your patient monitor defines how the alarm indicators behave when you do not acknowledge them. When alarms are set to non-latching, their alarm indications end when the alarm condition ends. If you switch alarm latching on, all visual and audible alarm indications last until you acknowledge the alarms, except that the measurement

numeric and violated alarm limit stop flashing as soon as the initial alarm condition goes away.

To set alarms to latching or non-latching:

1. Select the [**Alarm Setup**] QuickKey, or [**Main Menu**]→[**Alarm Setup** >>].
2. Select [**Latching Alarms**] and toggle between [**Yes**] and [**No**].

Technical alarms are always non-latching. You can clear the latched alarms by pressing the hardkey.

6.9 Clearing Technical Alarms

For some technical alarms, their alarm lamp flashing and alarm tones are cleared and the alarm messages change to prompt messages after the hardkey is pressed. After the patient monitor restores the normal status, the patient monitor can give alarm indications correctly when these alarms are triggered again.

For some other technical alarms, all their alarm indications are cleared after the hardkey is pressed. After the patient monitor restores the normal status, the patient monitor can give alarm indications correctly when these alarms are triggered again.

6.10 When an Alarm Occurs

When an alarm occurs, observe the following steps and take proper actions:

1. Check the patient's condition.
2. Confirm the alarming parameter or alarm category.
3. Identify the source of the alarm.
4. Take proper action to eliminate the alarm condition.
5. Make sure the alarm condition is corrected.

For troubleshooting specific alarms, see appendix ***Alarm Messages***.

FOR YOUR NOTES

7 Monitoring ECG/Resp

7.1 Introduction

The electrocardiogram (ECG) measures the electrical activity of the heart and displays it on the patient monitor as a waveform and a numeric. This patient monitor measures ECG using the MPM module. The MPM enables ECG monitoring and ECG analysis, of which ECG monitoring includes 3-, 5- and 12-lead ECG monitoring, and ECG analysis includes 12-lead ECG analysis only. This section also tells you about ST monitoring and arrhythmia monitoring.

Connector for ECG cable

Impedance respiration is measured across the thorax. When the patient is breathing or ventilated, the volume of air changes in the lungs, resulting in impedance changes between the electrodes. Respiration rate (RR) is calculated from these impedance changes, and a respiration waveform appears on the patient monitor screen.

7.2 Safety

⚠ WARNING

- **Use only ECG electrodes and cables specified in this manual.**
- **When connecting electrodes and/or patient cables, make sure that the connectors never come into contact with other conductive parts, or with earth. In particular, make sure that all of the ECG electrodes are attached to the patient, to prevent them from contacting conductive parts or earth.**
- **Periodically inspect the electrode application site to ensure skin quality. If the skin quality changes, replace the electrodes or change the application site.**
- **Use defibrillator-proof ECG cables during defibrillation. When monitoring the patient's respiration, ESU-proof cables should not be used.**
- **Do not touch the patient, or table, or instruments during defibrillation.**
- **After defibrillation, the screen display recovers within 10 seconds if the correct electrodes are used and applied in accordance with the manufacturer's instructions for use.**
- **Interference from a non-grounded instrument near the patient and electrosurgery interference can cause problems with the waveform.**

7.3 Preparing to Monitor ECG

7.3.1 Preparing the Patient and Placing the Electrodes

1. Prepare the patient's skin. Proper skin preparation is necessary for good signal quality at the electrode, as the skin is a poor conductor of electricity. To properly prepare the skin, choose flat, non-muscular areas and then follow this procedure:
   - ◆ Shave hair from skin at chosen sites.
   - ◆ Gently rub skin surface at sites to remove dead skin cells.
   - ◆ Thoroughly cleanse the site with a mild soap and water solution. We do not recommend using ether or pure alcohol, because this dries the skin and increases the resistance.
   - ◆ Dry the skin completely before applying the electrodes.
2. Attach the clips or snaps to the electrodes before placing them.
3. Place the electrodes on the patient.
4. Attach the electrode cable to the patient cable and then plug the patient cable into the ECG connector on the MPM.

7.3.2 Choosing AHA or IEC Lead Placement

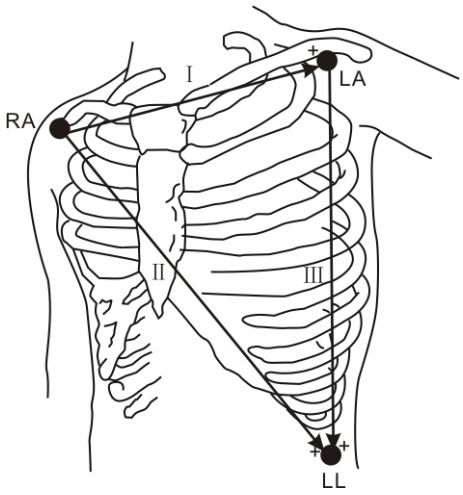
1. Select the ECG parameter window to enter the [**ECG Setup**] menu.
2. Select [**Lead Set**] and then select [**3-lead**], [**5-lead**] or [**12-lead**] according to the applied electrodes.
3. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password
4. Select [**Others >>**]→[**ECG Standard**] and then select [**AHA**] or [**IEC**] according to the standard that is applied for your hospital.

7.3.3 ECG Lead Placements

3-Leadwire Electrode Placement

Following is an electrode configuration when using 3 leadwires:

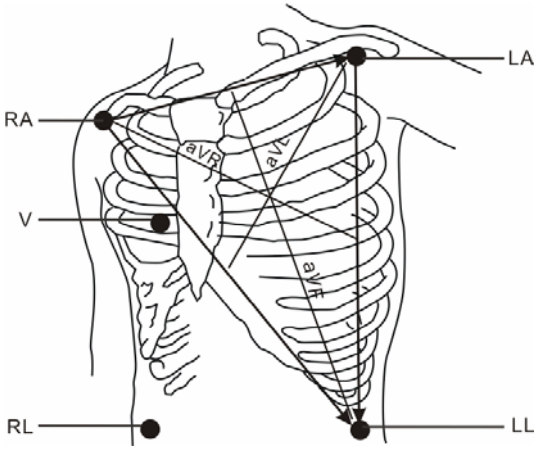
- RA placement: directly below the clavicle and near the right shoulder.
- LA placement: directly below the clavicle and near the left shoulder.
- LL placement: on the left lower abdomen.



5-Leadwire Electrode Placement

Following is an electrode configuration when using 5 leadwires:

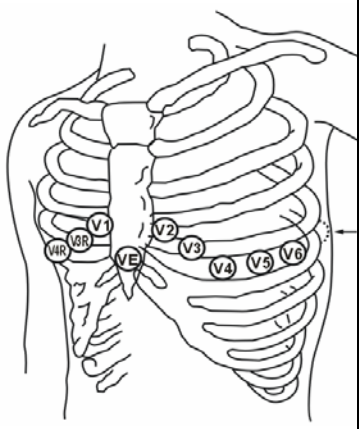
- RA placement: directly below the clavicle and near the right shoulder.
- LA placement: directly below the clavicle and near the left shoulder.
- RL placement: on the right lower abdomen.



- LL placement: on the left lower abdomen.
- V placement: on the chest.

The chest (V) electrode can be placed on one of the following positions:

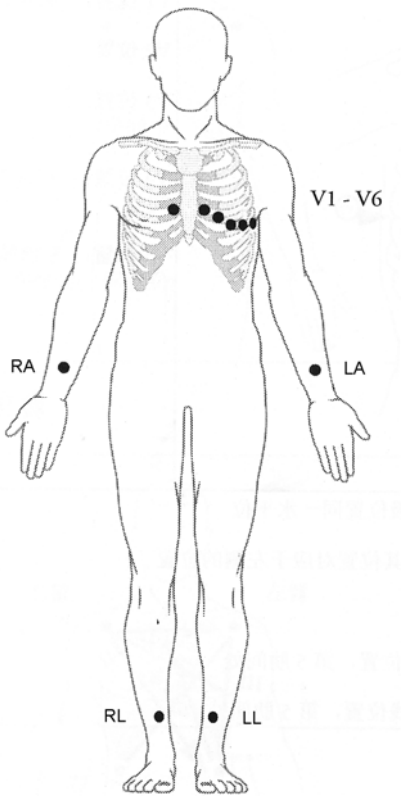
- V1 placement: on the fourth intercostal space at the right sternal border.
- V2 placement: on the fourth intercostal space at the left sternal border.
- V3 placement: midway between the V2and V4 electrode positions.
- V4 placement: on the fifth intercostal space at the left midclavicular line.
- V5 placement: on the left anterior axillary line, horizontal with the V4 electrode position.



- V6 placement: on the left midaxillary line, horizontal with the V4 electrode position.
- V3R-V6R placement: on the right side of the chest in positions corresponding to those on the left.
- VE placement: over the xiphoid process.
- V7 placement: on posterior chest at the left posterior axillary line in the fifth intercostal space.
- V7R placement: on posterior chest at the right posterior axillary line in the fifth intercostal space.

12-Leadwire Electrode Placement

12-lead ECG uses 10 electrodes, which are placed on the patient's four limbs and chest. The limb electrodes should be placed on the soft skin and the chest electrodes placed according to the physician's preference.



Lead Placement for Surgical Patients

The surgical site should be taken into consideration when placing electrodes on a surgical patient. e.g. for open heart surgery, the chest electrodes can be placed on the lateral chest or back. To reduce artifacts and interference from electrosurgical units, the limb electrodes can be placed close to the shoulders and lower abdomen and the chest electrodes on the left side of the mid-chest. Do not place the electrodes on the upper arm. Otherwise, the ECG waveform will be very small.

⚠ WARNING

- **When using electrosurgical units (ESU), place ECG electrodes between the grounding plate of the ESU and the ESU to prevent unwanted burns. Never entangle the ESU cable and the ECG cable together.**
- **When using electrosurgical units (ESU), never place ECG electrodes near to the grounding plate of the ESU, as this can cause a lot of interference on the ECG signal.**

7.3.4 Checking Paced Status

It is important to set the paced status correctly when you start monitoring ECG. The paced symbol is displayed when the [**Paced**] status is set to [**Yes**]. The pace pulse markers "|" are shown on the ECG wave when the patient has a paced signal.

To change the paced status, you can select either:

- the patient information area, or
- [**Main Menu**]→[**Patient Setup**]→[**Patient Demographics**], or,
- the ECG parameter window,

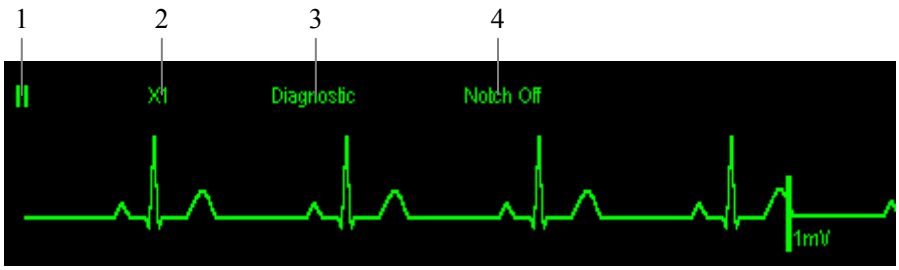
and then, select [**Paced**] from the popup menu and toggle between [**Yes**] and [**No**].

⚠Warning

- **For paced patients, you must set [Paced] to [Yes]. If it is incorrectly set to [No], the patient monitor could mistake a pace pulse for a QRS and fail to alarm when the ECG signal is too weak.**
- **For non-paced patients, you must set [Paced] to[No]. If it is incorrectly set to [Yes], the patient monitor may be unable to detect premature ventricular beats (including PVCs) and perform ST segment analysis.**

7.4 Understanding the ECG Display

Below is a 5-lead ECG display screen. Your display may be configured to look slightly different.



1. Lead label of the displayed wave
2. ECG gain
3. ECG filter label
4. Notch filter status

1. Current heart rate alarm limits
2. Current heart rate
3. Heart beat symbol

For 12-lead ECG display screen, refer to the section ***7.8 12-Lead ECG Monitoring***.

7.5 Changing ECG Settings

7.5.1 Accessing ECG Menus

By selecting the ECG parameter window, you can access the [**ECG Setup**] menu. By selecting any ECG wave, you can enter its lead menu.

7.5.2 Choosing the Alarm Source

In most cases the HR and PR numerics are identical. In order to avoid simultaneous alarms on HR and PR, the monitor uses either HR or PR as its active alarm source. To change the alarm source, select [Alm Source] in the [ECG Setup] menu and then select either:

- [**HR**]: if you want the HR to be the alarm source for HR/PR.
- [**PR**]: if you want the PR to be the alarm source for HR/PR.
- [**Auto**]: If the [Alm Source] is set to [Auto], the patient monitor will use the heart rate from the ECG measurements as the alarm source whenever a valid heart rate is available. If the heart rate becomes unavailable, for example the ECG module is turned off or becomes disconnected, the patient monitor will automatically switch to PR as the alarm source.

7.5.3 Choosing a 5-Lead ECG Display Screen

When monitoring with a 5-lead set, you can, in the [**ECG Setup**] menu, set the [**ECG Display**] screen to:

- [**Normal**]: The ECG waveform area shows 2 ECG waveforms.
- [**Full-Screen**]: The whole waveform area shows 7 ECG waveforms only.
- [**Half-Screen**]: The upper half part of the whole waveform area displays 7 ECG waveforms.

When [**ECG Display**] is set to [**Normal**] and [**Sweep Mode**] is set to [**Refresh**], cascaded ECG waveforms can be displayed. To cascade ECG waveforms:

1. Select either ECG wave to enter its lead menu.
2. Select [**Cascade**] and then select [**On**]. A cascaded waveform is displayed in two waveform positions.

7.5.4 Changing the ECG Filter Settings

The ECG filter setting defines how ECG waves are smoothed. Filter settings do not affect ST measurement. To change the filter setting, select [**Filter**] from [**ECG Setup**] and then select the appropriate setting.

- [**Monitor**]: Use under normal measurement conditions.
- [**Diagnostic**]: Use when diagnostic quality is required. The unfiltered ECG wave is displayed so that changes such as R-wave notching or discrete elevation or depression of the ST segment are visible.
- [**Surgery**]: Use when the signal is distorted by high frequency or low frequency interference. High frequency interference usually results in large amplitude spikes making the ECG signal look irregular. Low frequency interference usually leads to wandering or rough baseline. In the operating room, the surgery filter reduces artifacts and interference from electrosurgical units. Under normal measurement conditions, select [**Surgery**] may suppress the QRS complexes too much and then interfere with ECG analysis.

WARNING

- **The [Monitor] or [Surgery] filter may cause ECG waveform distortions and affect ST analysis, and the [Surgery] filter may affect arrhythmia analysis. Therefore, the [Diagnostic] filter is recommended when monitoring a patient in an environment with slight interference only.**

7.5.5 Switching the Notch Filter On or Off

The notch filter removes the line frequency interference. When [**Filter**] is not set to [**Diagnostic**], the notch filter always stays on. When [**Filter**] is set to [**Diagnostic**], you can switch the notch filter on or off as required.

1. Select the ECG parameter window to enter its setup menu.
2. Select [**Notch Filter**] and toggle between [**On**] and [**Off**]. Switching the notch filter on is recommended when there is interference (such as spikes) with the waveform.
3. When [**Notch Filter**] is set on, select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
4. Select [**Others >>**]→[**Notch Freq.**] and then select [**50Hz**] or [**60Hz**] according to the power line frequency.

7.5.6 Switching Defibrillator Synchronization On/Off

To switching defibrillator synchronization on or off:

1. Select the ECG parameter window to enter its setup menu.
2. Select [**Defib. Sync**] and toggle between [**On**] and [**Off**].

If a defibrillator is connected, a defibrillator synchronization pulse (100 ms, +5V) is outputted through the Defib. Sync Connector every time when the patient monitor detects an R-wave. When [**Dfib. Sync**] is set on, the message [**Defib Sync On**] is displayed in the technical alarm area.

⚠WARNING

- **Improper use of a defibrillator may cause injury to the patient. The user should determine whether to perform defibrillation or not according to the patient's condition.**
- **Before defibrillation, the user must ensure both defibrillator and monitor has passed the system test and can be safely used jointly.**
- **Before defibrillation, make sure that [Defib. Sync] is set to [On] and the [Filter] is set to [Diagnostic].**
- **After defibrillation is finished, set [Defib. Sync] to [Off] and select the filter mode as required.**

7.5.7 Changing ECG Wave Settings

To change a wave's settings, select the wave you want to change to enter its lead menu. In the lead menu:

- If the wave is too small or clipped, you can change its size by selecting an appropriate [**Gain**] setting. If you select [**Auto**] from [**Gain**], the patient monitor will automatically adjusting the size of the ECG waves. In [**Normal**] screen, only the selected ECG wave's size is adjusted. In other screens, all ECG waves' size is adjusted simultaneously.
- You can change the wave sweep speed by selecting [**Sweep**] and then selecting the appropriate setting.
- You can adjust a wave's position by adjusting the or button beside [**Up and Down**] button.
- You can restore a wave to its original position by selecting [**Back to Default**].

7.5.8 Choosing the Heart Rate Source

The patient monitor uses a lead to compute HR and to analyse and detect arrhythmia. You should choose a lead of best quality signals as the HR lead. To select a lead as the HR lead, in [**Normal**] screen, select the wave corresponding to the HR parameter to enter its lead menu. In the lead menu, select [**HR Source**] and then select the lead you want.

The selected lead should have the following characteristics:

- The QRS should be either completely above or below the baseline and it should not be biphasic.
- The QRS should be tall and narrow.
- The P-waves and T-waves should be less than 0.2mV.

7.6 About ST Monitoring

- ST segment analysis is only for use on adult patients. The default setting is off.
- ST segment analysis calculates ST segment elevations and depressions for individual leads and then displays them as numerics in the ST1 and ST2 areas.
- A positive value indicates ST segment elevation; a negative value indicates ST segment depression.
- Measurement unit of the ST segment: mV.
- Measurement range of the ST segment: -2.0 mV to +2.0 mV.

7.6.1 Switching ST On and Off

To switch ST monitoring on or off:

1. In the [**ECG Setup**] menu, select [**ST Analysis** >>].
2. Select [**ST Analysis**] to toggle between [**On**] and [**Off**].

When ST monitoring is switched on, the patient monitor selects the [**Diagnostic**] filter mode automatically. You can also select the [**Monitor**] or [**Surgery**] filter mode. But in that case, the ST numerics may be severely distorted.

By selecting the ST parameter window, you can enter the [**ST Analysis**] menu.

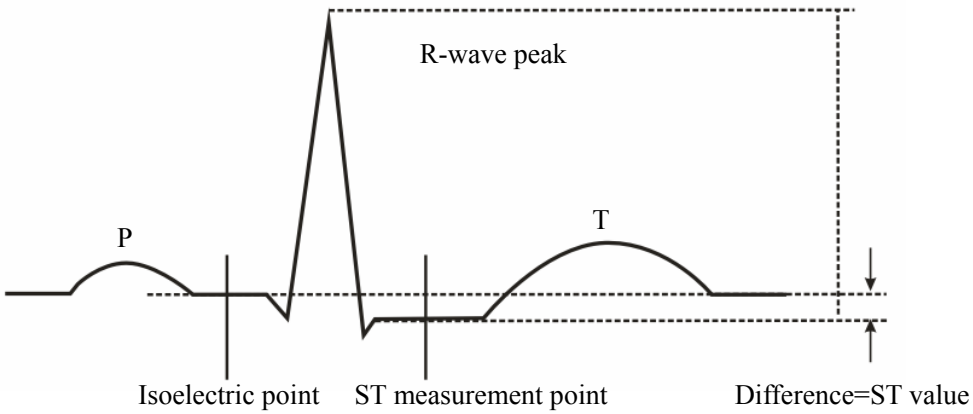
7.6.2 Changing the ST Alarm Limits

High and low ST alarm limits can be set individually for each ECG lead. Alarm limits can also be set separately for single-lead and multi-lead ST monitoring. For 3-lead ECG monitoring, you can directly change the ST alarm limits in the [**ST Analysis**] menu. For 5- or 12-lead ECG monitoring, you can select [**Adjust ST Limits >>**] from [**ST Analysis**] and then set the ST alarm limits for each lead.

7.6.3 Adjusting ST Measurement Points

The ST measurement points need to be adjusted if the patient's heart rate or ECG morphology changes significantly. To adjust the ST measurement points:

1. In the [**ST Analysis**] menu, select [**Adjust ST Points >>**] to open the [**Adjust ST Points**] window.
2. Select [**ISO**] or [**ST**] that you need to adjust and then use the ◀ and ▶ arrow keys to move the measurement points.
   - ISO-point (isoelectric): provides baseline for the measurement.
   - ST: marks the end point of the ST segment analysis.



As shown above, the peak of the R-wave is the reference point for ST measurement. The ST measurement for each beat complex is the vertical difference between two measurement points.

NOTE

- **Abnormal QRS complex is not taken into consideration for ST segment analysis.**

7.7 About Arrhythmia Monitoring

Arrhythmia analysis provides information about your patient's condition, including heart rate, PVC rate, rhythm and ectopics.

7.7.1 Switching Arrhythmia Analysis On and Off

To switch arrhythmia analysis on or off:

1. In the [**ECG Setup**] menu, select [**Arrh. Analysis** >>].
2. Select [**Arrh. Analysis**] to toggle between [**On**] and [**Off**].

7.7.2 Changing Arrhythmia Alarm Settings

Arrhythmia alarms can be switched on and off, and other alarm settings such as alarm limits, alarm level, etc. can be changed just like other measurement alarms, as described in the Alarms section. In the [**Arrh. Analysis**] menu, you can change alarm settings for all arrhythmia events. You can also select [**Arrh. Alarm Setup** >>] from the [**Arrh. Analysis**] menu and then change alarm settings for individual arrhythmia events.

7.7.3 Initiating Arrhythmia Relearning Manually

To initiate relearning manually, in the [**ECG Setup**] menu, select [**Arrh. Analysis** >>]→ [**Relearn Arrh.**]. When the patient monitor is learning, the message [**Arrh. Learning**] is displayed in the technical alarm area.

7.7.4 Automatic Arrhythmia Relearn

Arrhythmia relearning is initiated automatically whenever:

- The ECG lead or lead label is changed
- The ECG lead is re-connected
- A new patient is admitted
- The paced status setting is changed
- A switch happens between [**Normal**] and [**12-Lead**] display when monitoring 12-lead ECG.

7.7.5 Reviewing Arrhythmia Events

To review previously happened arrhythmia events, in the [**ECG Setup**] menu, select [**Arrh. Analysis >>**]→[**Arrh. Review >>**].

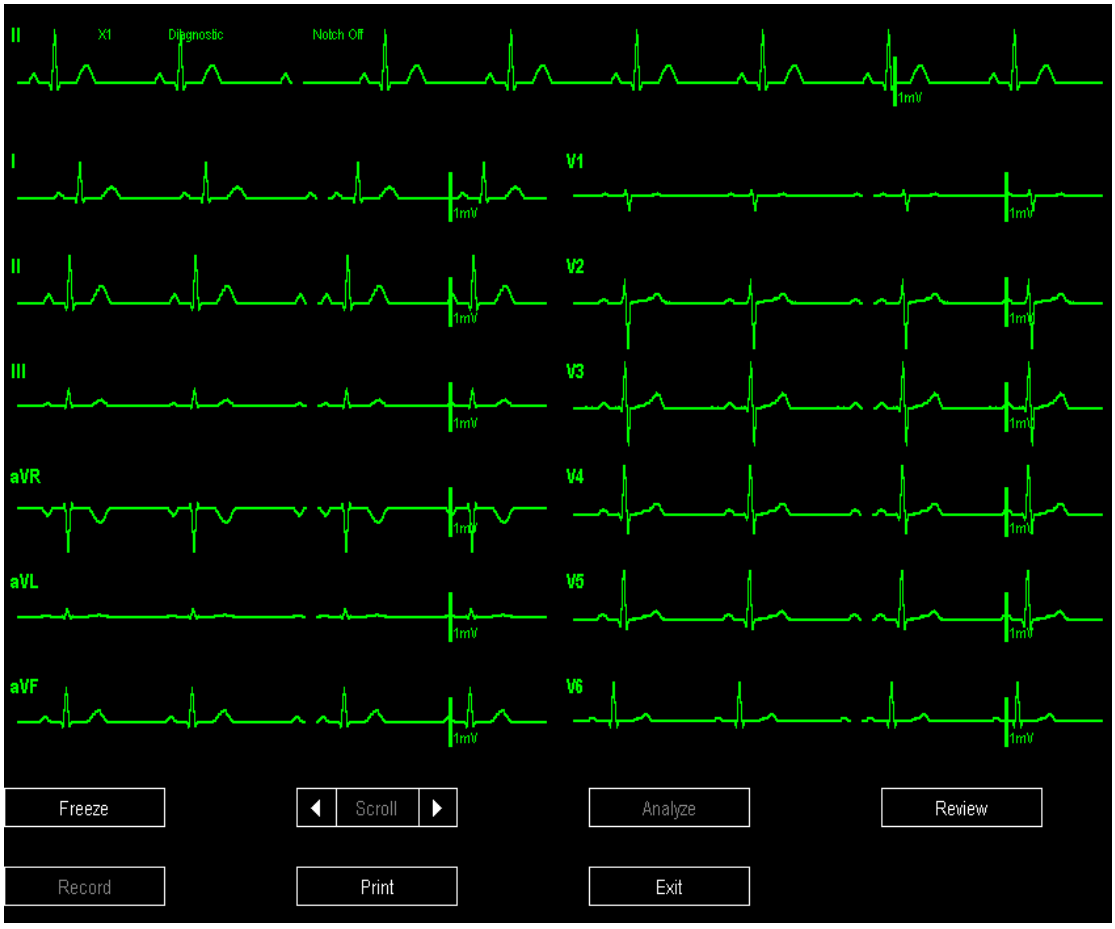
In the [**Arrh. Review**] window, you can:

- Select [**Index**] and then set a time as the index for finding your desired arrhythmia events.
- Select an arrhythmia event for viewing.
  - The event list displays a few events only. You can have more event selections by selecting or .
  - You can select or beside [**Scroll**] to navigate through the arrhythmia waveforms.
- Rename an arrhythmia event by selecting the arrhythmia event you want to rename and then selecting [**Rename**].
- Delete an arrhythmia event by selecting the one you want to delete and then selecting [**Delete Event**].
- Print out the currently displayed arrhythmia waveforms and numerics by selecting [**Record**].

7.8 12-Lead ECG Monitoring

7.8.1 Entering the 12-lead ECG Analysis Program

1. Refer to the section ***7.3.3 ECG Lead Placements*** for placing the electrodes.
2. In the [**ECG Setup**] menu, select [**Lead Set**]→[**12-Lead**], and select [**ECG Display**]→[**12-Lead**].



The ECG numerics are displayed above the ECG wave. There are totally 12 ECG waves and 1 rhythm wave displayed on the screen. Before entering the 12-lead ECG analysis program, the rhythm lead is the lead from which HR is derived. The ST numerics are displayed in three groups:

- ST Ant (anterior): V1, V2, V3, V4
- ST Inf (inferior): II, III, aVF, (aVR)
- ST Lat (lateral): I, aVL, V5, V6

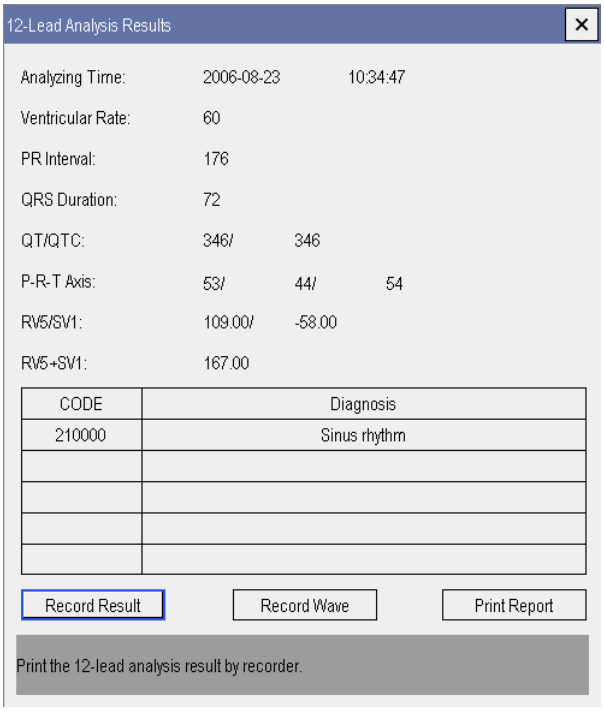
Additionally, the 12-lead ECG monitoring has the following features:

- The [**Filter**] mode is fixed to [**Diagnostic**] and cannot be changed.
- The on-screen QuickKey and the hardkey on the monitor's front are disabled.

7.8.2 12-Lead ECG Analysis

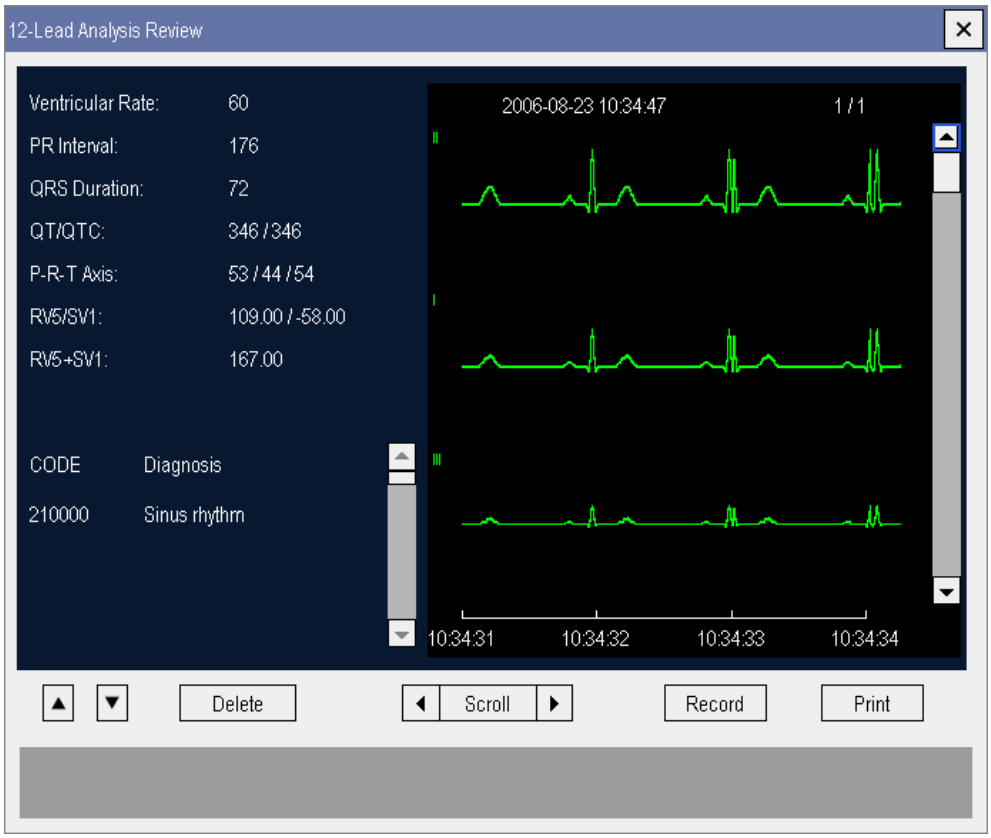
You can only start a 12-lead ECG analysis 11 seconds after entering the 12-lead ECG analysis program. Otherwise, the prompt message [**Not enough data. Cannot analyze.**] will be displayed. In the 12-lead ECG analysis window:

- Select [**Freeze**]. All ECG waves except the rhythm wave are frozen, and the [**Freeze**] button changes to [**Unfreeze**].
- If you want to browse the frozen ECG waves, select [**Scroll**] and rotate the Knob, or select the or button beside [**Scroll**].
- You can print out the currently frozen waves by selecting [**Record**].
- After the waves are frozen, you can start a 12-lead ECG analysis by selecting [**Analyze**]. Then, you can select [**Record Result**] to pint out 12-lead ECG analysis results by the recorder, or select [**Record Wave**] to print out 12-lead ECG analysis results and waves.



7.8.3 Reviewing 12-Lead ECG Analysis Results

In the 12-lead ECG analysis window, you can review previous 12-lead ECG analyses by selecting [**Review**].



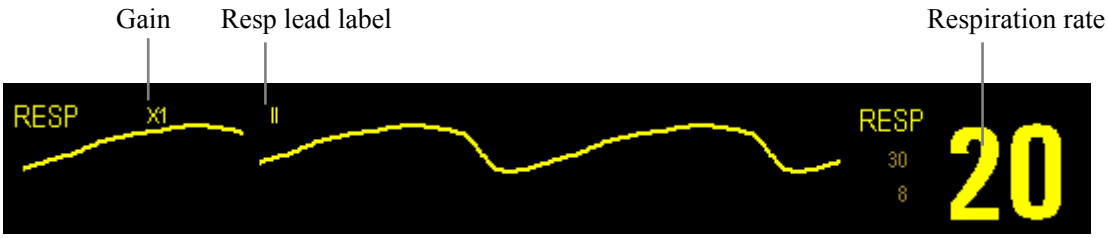
In this review window, you can:

- Select a set of 12-lead ECG analysis results for viewing. This window displays a set of 12-lead ECG analysis results only. You can view other sets of 12-lead ECG analysis results by selecting ▲ or ▼ beside the [**Delete**] button.
- Select ◀ or ▶ beside [**Scroll**] to navigate through the waveforms.
- Delete the currently displayed 12-lead ECG analysis results by selecting [**Delete**].
- Select [**Record**] to print out the currently displayed 12-lead ECG analysis results by the recorder.

7.9 Monitoring Respiration (Resp)

7.9.1 Understanding the Resp Display

The Resp measurement is displayed on the patient monitor as a continuous wave and a numeric respiration rate (RR).



By selecting the waveform area, you can enter the [**Resp Waveform**] menu. By selecting the Resp parameter window, you can enter the [**Resp Setup**] menu.

NOTE

- **Respiration monitoring is not for use on the patients who are very active, as this will cause false alarms.**

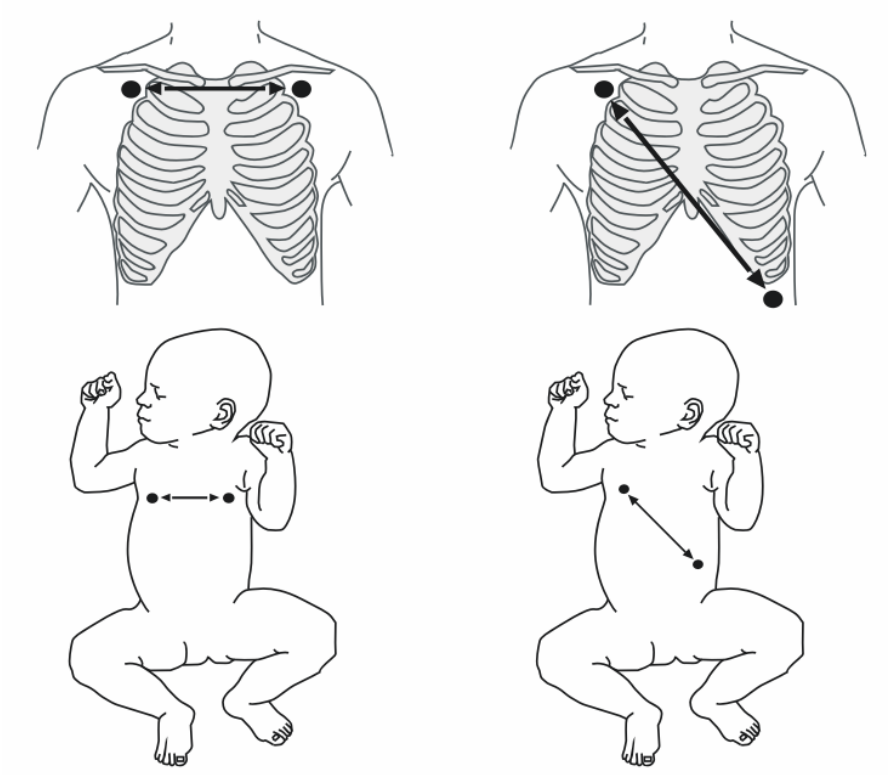
7.9.2 Placing Resp Electrodes

Since the same electrodes are used for ECG and respiration monitoring, correct electrode placement is very important. Some patients, due to their clinical condition, expand their chests laterally, causing a negative intrathoracic pressure. In these cases, it is better to place the two respiration electrodes in the right midaxillary and left lateral chest areas at the patient's maximum point of the breathing movement to optimize the respiratory waveform.

NOTE

- **When monitoring the patient's respiration, ESU-proof cables should not be used.**
- **To optimize the respiration waveform, place the RA and LA electrodes horizontally when monitoring respiration with ECG Lead I; place the RA and LL electrodes diagonally when monitoring respiration with ECG Lead II.**
- **To reduce cardiac overlay or artifacts from pulastile blood flow, avoid the liver**

area and the ventricles of the heart in the line between the respiratory electrodes. This is particularly important for neonates.



Lead I Lead II

7.9.3 Choosing the Respiration Lead

In the [**Resp Waveform**] menu, select [**Lead**] and toggle between [**I**] and [**II**].

7.9.4 Changing the Apnea Alarm Delay

The apnea alarm is a high-level alarm used to detect apneas. You can set the apnea alarm delay time after which the patient monitor alarms if the patient stops breathing. In the [**Resp Setup**] menu, select [**Apnea Time**] and then select the appropriate setting.

7.9.5 Changing Resp Detection Mode

In either [**Resp Setup**] or [**Resp Waveform**] menu, select [**Detection Mode**] and toggle between [**Auto**] and [**Manual**].

- In auto detection mode, the patient monitor adjusts the detection level automatically, depending on the wave height and the presence of cardiac artifact. Note that in auto detection mode, the detection level (a dotted line) is not displayed on the waveform.

  Use auto detection mode for situations where:

  - The respiration rate is not close to the heart rate.
  - Breathing is spontaneous, with or without continuous positive airway pressure (CPAP).
  - Patients are ventilated, except patients with intermittent mandatory ventilation (IMV).

- In manual detection mode, you adjust the dotted detection level line to the desired level by selecting [**Upper Line**] or [**Lower Line**] and then selecting ▲ or ▼ beside them. Once set, the detection level will not adapt automatically to different respiration depths. It is important to remember that if the depth of breathing changes, you may need to change the detection level.

  Use manual detection mode for situations where:

  - The respiration rate and the heart rate are close.
  - Patients have intermittent mandatory ventilation.
  - Respiration is weak. Try repositioning the electrodes to improve the signal.

7.9.6 Changing Resp Wave Settings

⚠WARNING

- **When monitoring in manual detection mode, make sure to check the respiration detection level after you have increased or decreased the size of the respiration wave.**

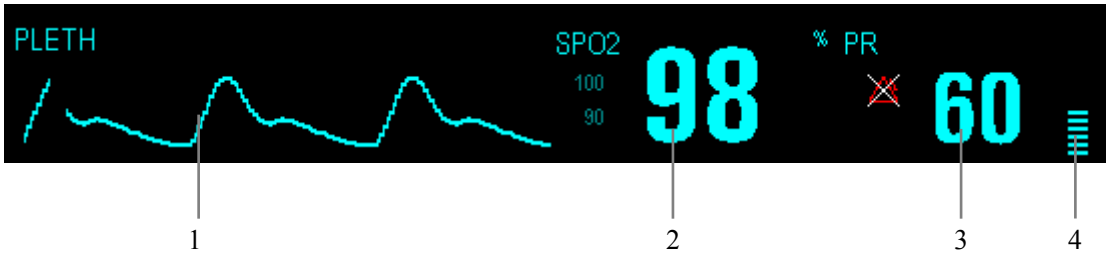
In the [**Resp Waveform**] menu, you can:

- Select [**Gain**] and then select an appropriate setting. The bigger the gain is, the larger the wave amplitude is.
- Select [**Sweep**] and then select an appropriate setting. The faster the wave sweeps, the wider the wave is.

8 Monitoring SpO_2

8.1 Introduction

SpO_2 monitoring is a non-invasive technique used to measure the amount of oxygenated haemoglobin and pulse rate by measuring the absorption of selected wavelengths of light. The light generated in the probe passes through the tissue and is converted into electrical signals by the photodetector in the probe. The SpO_2 module processes the electrical signal and displays a waveform and digital values for SpO_2 and pulse rate. It provides four measurements:



1. Pleth waveform (Pleth): visual indication of patient's pulse.
2. Oxygen saturation of arterial blood (SpO_2): percentage of oxygenated hemoglobin in relation to the sum of oxyhemoglobin and deoxyhemoglobin.
3. Pulse rate (derived from pleth wave): detected pulsations per minute.
4. Perfusion indicator: the pulsatile portion of the measured signal caused by arterial pulsation.

8.2 Safety

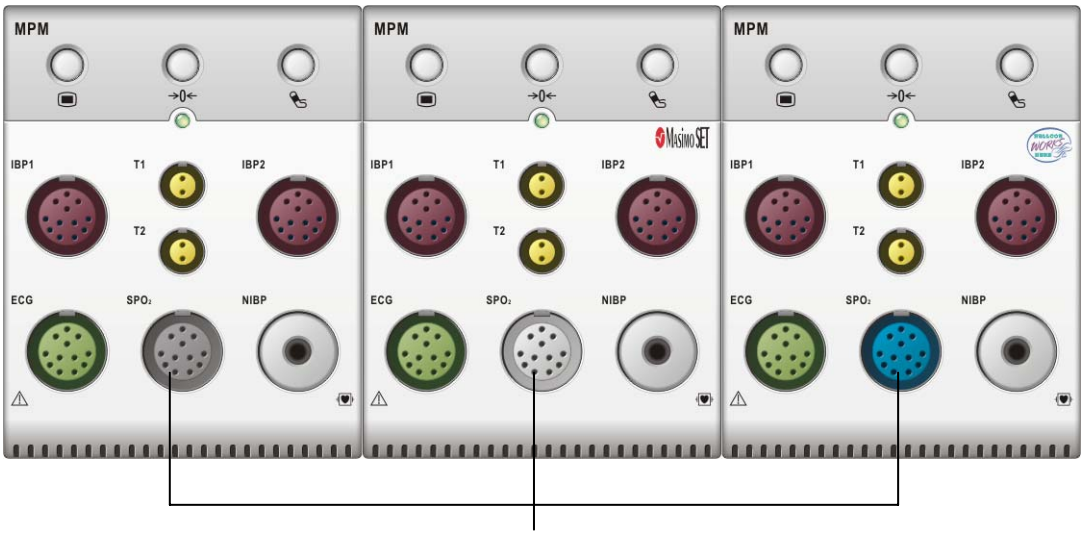
⚠ WARNING

- **Use only SpO_2 sensors specified in this manual. Follow the SpO_2 sensor's instructions for use and adhere to all warnings and cautions.**
- **When a trend toward patient deoxygenation is indicated, blood samples should be analyzed by a laboratory co-oximeter to completely understand the patient's condition.**
- **Do not use SpO_2 sensors during magnetic resonance imaging (MRI). Induced current could potentially cause burns. The sensor may affect the MRI image, and the MRI unit may affect the accuracy of the oximetry measurements.**
- **Interference can be caused by: high level of ambient light; electromagnetic interference; excess patient movement and vibration.**
- **Prolonged continuous monitoring may increase the risk of undesirable changes in skin characteristics, such as irritation, reddening, blistering or burns. Inspect the sensor site every two hours and move the sensor if the skin quality changes. For neonates, or patients with poor peripheral blood circulation or sensitive skin, inspect the sensor site more frequently.**

8.3 Identifying SpO_2 Modules

To identify which SpO_2 module is incorporated into your MPM, see the company logo located at the right upper corner as shown below:

- MPM SpO_2 module: no logo.
- Masimo SpO_2 module: Masimo SET.
- Nellcor SpO_2 module: Nellcor.



Connector for SpO_2 cable

8.4 Applying the Sensor

1. Select an appropriate sensor according to the module type, patient category and weight.
2. Remove colored nail polish from the application site.
3. Apply the sensor to the patient.
4. Select an appropriate adapter cable according to the connector type and plug this cable into the MPM.
5. Connect the sensor cable to the adapter cable.

8.5 Changing SpO_2 Settings

8.5.1 Accessing SpO_2 Menus

- By selecting the SpO_2 parameter window, you can access the [**SpO2 Setup**] menu.
- By selecting the PR numeric, you can access the [**PR Setup**] menu.
- By selecting the Pleth wave, you can access the [**Pleth Waveform**] menu.

8.5.2 Adjusting the Desat Alarm Limit

The desat alarm is a high level alarm notifying you of potentially life threatening drops in oxygen saturation. To adjust the desat alarm limit, select [**Desat Limit]** in the [**SpO2 Setup**] menu and then adjust the limit. When the SpO_2 value is below the desat alarm limit, the message [**SpO2 Desat]** is displayed. In this case, the monitor will not alarm if other physiological alarms occur.

8.5.3 Setting SpO_2 Sensitivity

To set the SpO_2 measurement sensitivity for MPM SpO_2 module, select [**Sensitivity**] in the [**SpO2 Setup]** menu and toggle between [**High**], [**Med**] and [**Low**].

- [**High**]: The monitor gives quick response to changes in the oxygen saturation level, but the measurement accuracy might be compromised. When monitoring critically ill patients, it is recommended that the measurement sensitivity is set to [**High**] so that you can timely understand the patient's state of illness.
- [**Low**]: The monitor gives slow response to changes in the oxygen saturation level, but the measurement accuracy is relatively high.

For Masimo SpO_2 modules, you can set the SpO_2 measurement sensitivity to [**Normal**] or [**Maximum**]. The [**Normal**] and [**Maximum**] sensitivities respectively correspond to the [**High**] and [**Low**] sensitivities mentioned above.

8.5.4 Monitoring SpO_2 and NIBP Simultaneously

When monitoring SpO_2 and NIBP on the same limb simultaneously, you can switch [**NIBP Simul**] on in the [**SpO2 Setup**] menu to lock the SpO_2 alarm status until the NIBP measurement ends. If you switch [**NIBP Simul**] off, low perfusion caused by NIBP measurement may lead to inaccurate SpO_2 readings and therefore cause false physiological alarms.

8.5.5 Sat-Seconds Alarm Management

The Sat-Seconds feature is available with the Nellcor SpO_2 module to decrease the likelihood of false alarms caused by motion artifacts. To set the Sat-Seconds limit, select [**Sat-Seconds**] in the [**SpO2 Setup**] menu and then select the appropriate setting.

With traditional alarm management, high and low alarm limits are set for monitoring oxygen saturation. During monitoring, as soon as an alarm limit is violated, an audible alarm immediately sounds. When the patient % SpO_2 fluctuates near an alarm limit, the alarm sounds each time the limit is violated. Such frequent alarm can be distracting. Nellcor's Sat-Seconds alarm management technique is used to reduce these nuisance alarms.

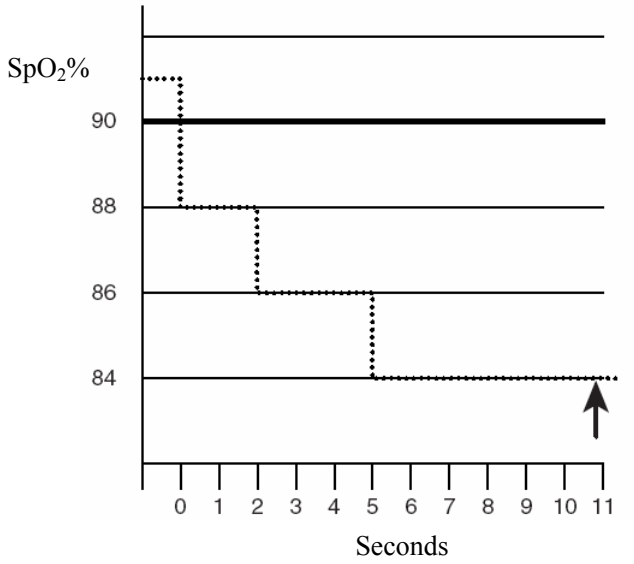
With Sat-Seconds alarm management, high and low alarm limits are set in the same way as traditional alarm management. A Sat-Seconds limit is also set. The Sat-Seconds limit controls the amount of time that SpO_2 saturation may be outside the set limits before an alarm sounds. The method of calculation is as follows: the number of percentage points that the SpO_2 saturation falls outside the alarm limit is multiplied by the number of seconds that it remains outside the limit. This can be stated as the equation:

Sat-Seconds= Points × Seconds

Only when the Sat-Seconds limit is reached, the monitor gives a Sat-Seconds alarm. For example, the figure below demonstrates the alarm response time with a Sat-Seconds limit set at 50 and a low SpO_2 limit set at 90%. In this example, the patient % SpO_2 drops to 88% (2 points) and remains there for 2 seconds. Then it drops to 86% (4 points) for 3 seconds, and then to 84% (6 points) for 6 seconds. The resulting Sat-Seconds are:

% SpO2	Seconds	Sat-Seconds
2×	2=	4
4×	3=	12
6×	6=	36
Total Sat-Seconds=		52

After approximately 10.9 seconds, a Sat-Second alarm would sound, because the limit of 50 Sat-Seconds would have been exceeded.



Saturation levels may fluctuate rather than remaining steady for a period of several seconds. Often, the patient % SpO_2 may fluctuate above and below an alarm limit, re-entering the non-alarm range several times. During such fluctuation, the monitor integrates the number of %SpO_2 points, both positive and negative, until either the Sat-Seconds limit is reached, or the patient%SpO_2 re-enters the non-alarm range and remains there.

8.5.6 Setting the Pulse Rate

In the [**SpO2 Setup**] menu, select [**PR Setup**] to enter the [**PR Setup**] menu. In the [**PR Setup**] menu, you can:

- Select [**PR**] and then select either:
  - [**On**] to display the PR parameter window, or
  - [**Off**] to hide the PR parameter window.
- Select [**Alm Source**] and then select either:
  - [**HR**]: if you want the HR to be the alarm source.
  - [**PR**] if you want the PR to be the alarm source.
  - [**Auto**]: If the [**Alm Source**] is set to [**Auto**], the monitor will use the heart rate from the ECG measurement as the alarm source whenever a valid heart rate is available. If the ECG signal is too weak, the monitor will automatically switch to PR as the alarm source. As soon as the ECG signal recovers, the monitor will automatically switch back to the heart rate as the alarm source.

8.5.7 Changing the Speed of the Pleth Wave

In the [**Pleth Waveform**] menu, select [**Sweep**] and and then select the appropriate setting. The faster the waveform sweeps, the wider the waveform is.

8.6 Masimo Information

- Masimo Patents

This device is covered under one or more the following U.S. Patents: 5,482,036; 5,490,505; 5,632,272; 5,685,299; 5,758,644; 5,769,785; 6,002,952; 6,036,642; 6,067,462; 6,206,830; 6,157,850 and international equivalents. U.S.A international patents pending.

- No Implied License

Possession or purchase of this device does not convey any express or implied license to use the device with unauthorized replacement parts which would, alone, or in combination with this device, fall within the scope of one or more of the patents relating to this device.

8.7 Nellcor Information

- Nellcor Patents

This device is covered under one or more the following U.S. Patents: 4,802,486; 4,869,254; 4,928,692; 4,934,372; 5,078,136; 5,351,685; 5,485,847; 5,533,507; 5,577,500; 5,803,910; 5,853,364; 5,865,736; 6,083,172; 6,463,310; 6,591,123; 6,708,049; Re.35,122 and international equivalents. U.S.A international patents pending.

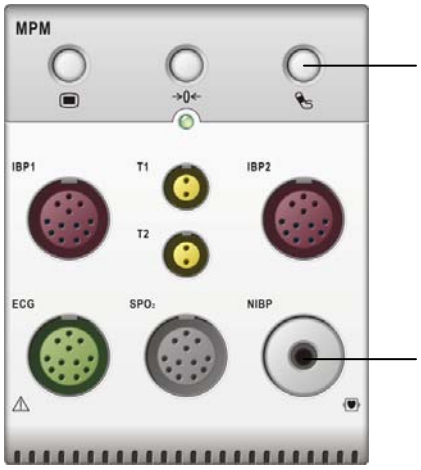
- No Implied License

Possession or purchase of this device does not convey any express or implied license to use the device with unauthorized replacement parts which would, alone, or in combination with this device, fall within the scope of one or more of the patents relating to this device.

9 Monitoring NIBP

9.1 Introduction

The MPM uses the oscillometric method for measuring the non-invasive blood pressure (NIBP). This measurement can be used for adults, pediatrics and neonates.



Automatic non-invasive blood pressure monitoring uses the oscillometric method of measurement. To understand how this method works, we'll compare it to the auscultative method. With auscultation, the clinician listens to the blood pressure and determines the systolic and diastolic pressures. The mean pressure can then be calculated with reference to these pressures as long as the arterial pressure curve is normal

Since the monitor cannot hear the blood pressure, it measures cuff pressure oscillation amplitudes. Oscillations are caused by blood pressure pulses against the cuff. The oscillation with the greatest amplitude is the mean pressure. This is the most accurate parameter measured by the oscillometric method. Once the mean pressure is determined, the systolic and diastolic pressures are calculated with reference to the mean.

Simply stated, auscultation measures systolic and diastolic pressures and the mean pressure is calculated. The oscillometric method measures the mean pressure and determines the systolic and diastolic pressures.

9.2 Safety

⚠ WARNING

- **Be sure to select the correct patient category setting for your patient before measurement. Do not apply the higher adult settings for pediatric or neonatal patients. Otherwise it may present a safety hazard.**
- **Do not measure NIBP on patients with sickle-cell disease or any condition where skin damage has occurred or is expected.**
- **Use clinical judgement to determine whether to perform frequent unattended blood pressure measurements on patients with severe blood clotting disorders because of the risk of hematoma in the limb fitted with the cuff.**
- **Do not use the NIBP cuff on a limb with an intravenous infusion or arterial catheter in place. This could cause tissue damage around the catheter when the infusion is slowed or blocked during cuff inflation.**
- **If you doubt the NIBP readings, determines the patient's vital signs by alternative means and then verify that the monitor is working correctly.**

9.3 Measurement Limitations

Measurements are impossible with heart rate extremes of less than 40bpm or greater than 240bpm, or if the patient is on a heart-lung machine.

The measurement may be inaccurate or impossible:

- If a regular arterial pressure pulse is hard to detect
- With excessive and continuous patient movement such as shivering or convulsions
- With cardiac arrhythmias
- Rapid blood pressure changes
- Severe shock or hypothermia that reduces blood flow to the peripheries
- Obesity, where a thick layer of fat surrounding a limb dampens the oscillations coming from the artery

9.4 Measurement Methods

There are three methods of measuring NIBP:

- Manual: measurement on demand.
- Auto: continually repeated measurements at set intervals.
- STAT: continually rapid series of measurements over a five minute period, then return to the previous mode.

9.5 Setting Up the NIBP Measurement

9.5.1 Preparing to Measure NIBP

1. Power on the monitor.
2. Verify that the patient category is correct. Change it if necessary.
3. Plug the air tubing into the NIBP connector on the MPM module.
4. Select a correct sized cuff and then apply it as follows:
   - Determine the patient's limb circumference.
   - Select an appropriate cuff by referring to the limb circumference marked on the cuff. The width of the cuff should be 40% (50% for neonates) of the limb circumference, or 2/3 of the upper arm's length. The inflatable part of the cuff should be long enough to encircle at least 50% to 80% of the limb.
   - Apply the cuff to an upper arm or leg of the patient and make sure the Φ marking on the cuff matches the artery location. Do not wrap the cuff too tightly around the limb. It may cause discoloration, and ischemia of the extremities. Make sure that the cuff edge falls within the marked range. If it does not, use a larger or smaller cuff that will fit better.
5. Connect the cuff to the air tubing and make sure that the bladder inside the cover is not folded and twisted.

9.5.2 Starting and Stopping Measurements

You can start and stop measurements by using the hardkey on either the monitor's front panel or the MPM module, or the on-screen QuickKey.

9.5.3 Correcting the Measurement if Limb is not at Heart Level

The cuffed limb should be at the same level as the patient's heart. If the limb is not at the heart level, to the displayed value:

- Add 0.75mmHg (0.10kPa) for each centimetre higher, or
- Deduct 0.75mmHg (0.10kPa) for each centimeter lower.

9.5.4 Enabling NIBP Auto Cycling and Setting the Interval

1. Select the NIBP parameter window to enter the [**NIBP Setup**] menu.
2. Select [**Interval**] and then select a desired time interval. Selecting [**Off**] switches to manual mode.
3. Start a measurement manually. Then monitor will then automatically repeat NIBP measurements at the set time interval.

⚠WARNING

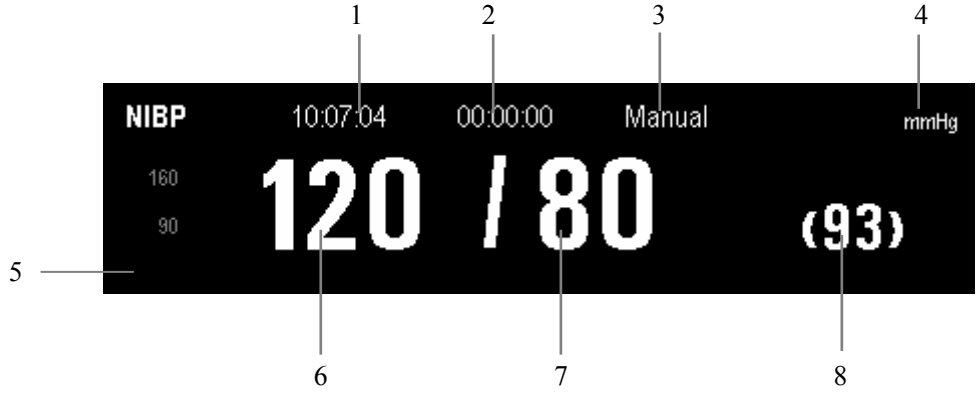
- **Continuous non-invasive blood pressure measurements may cause purpura, ischemia and neuropathy in the limb with the cuff. Inspect the application site regularly to ensure skin quality and inspect the extremity of the cuffed limb for normal color, warmth and sensitivity. If any abnormity occurs, move the cuff to another site or stop the blood pressure measurements immediately.**

9.5.5 Starting a STAT Measurement

1. Select the NIBP parameter window to enter the [**NIBP Setup**] menu.
2. Select [**NIBP STAT**]. The STAT mode initiates 5 minutes of continuous, sequential, automatic NIBP measurements.

9.6 Understanding the NIBP Numerics

The NIBP display shows numerics only as below:



1. Time of last measurement
2. Time remaining to next measurement
3. Measurement mode
4. Unit of pressure: mmHg or kPa
5. Prompt message area: shows NIBP-related prompt messages
6. Systolic pressure
7. Mean pressure
8. Diastolic pressure

9.7 Changing NIBP Settings

By selecting the NIBP parameter window, you can enter the [**NIBP Setup**] menu.

9.7.1 Choosing NIBP Alarm Source

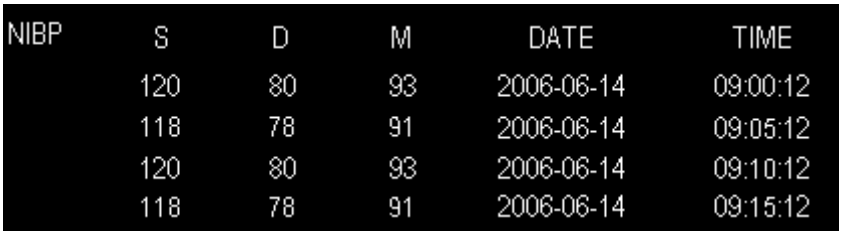
You can monitor for alarm conditions in systolic, diastolic and measure pressure, either singly or parallel. In the [**NIBP Setup**], select [**Alm Source**] and choose from:

- [**Sys]**: alarms are given only when the systolic pressure violates the alarm limits.
- [**Dia**]: alarms are given only when the diastolic pressure violates the alarm limits.
- [**Mean**]: alarms are given only when the mean pressure violates the alarm limits.
- [**Sys&Mean**]: alarms are given when the systolic or mean pressure violates the alarm limits.
- [**Mean&Dia**]: alarms are given when the mean or diastolic pressure violates the alarm limits.
- [**Sys&Dia**]: alarms are given when the systolic or diastolic pressure violates the alarm limits.
- [**All**]: alarms are given when the systolic or mean or diastolic pressure violates the alarm limits.

9.7.2 Displaying NIBP Measurements

You can display one set or multiple sets of NIBP measurements simultaneously. In the [**NIBP Setup**] menu, select [**Display NIBP**] and toggle between [**Single-Group**] and [**Multi-Group**]:

- [**Single-Group**]: only the latest set of NIBP measurements is displayed in the NIBP parameter window.
- [**Multi-Group**]: multiple sets of most recent NIBP measurements are displayed below the waveform area.



You can not display multiple sets of NIBP measurements in some screens such as the big numerics screen and the 12-lead ECG analysis screen.

9.7.3 Setting the Pressure Unit

In the [**NIBP Setup**] menu, select [**Unit**] and toggle between [**mmHg**] and [**kPa**].

9.8 Assisting Venous Puncture

You can use the NIBP cuff to cause sub-diastolic pressure to block the venous blood vessel and therefore help venous puncture.

1. In the [**NIBP Setup**] menu, verify that the [**Cuff Press.**] value is appropriate. Change it if necessary.
2. Select [**VeniPuncture**].
3. Puncture vein and draw blood sample.
4. Reselect either [**VeniPuncture**], or the hardkey on the monitor's front, or the on-screen QuickKey to deflate the cuff. The cuff deflates automatically after a set time if you do not deflate it.

During measurement, the NIBP display shows the inflation pressure of the cuff and the remaining time in venous puncture mode.

9.9 Resetting NIBP

If the blood pressure pump works incorrectly but the monitor does not alarm for it, you can check the pump by resetting it. To reset the pump, select [**Reset**] from [**NIBP Setup**].

9.10 NIBP Leakage Test

The NIBP leakage test checks the integrity of the system and of the valve. It is required once every two years or when you doubt the measured NIBP. If the test failed, corresponding prompt messages will be given. If no message is displayed, it means no leakage is detected.

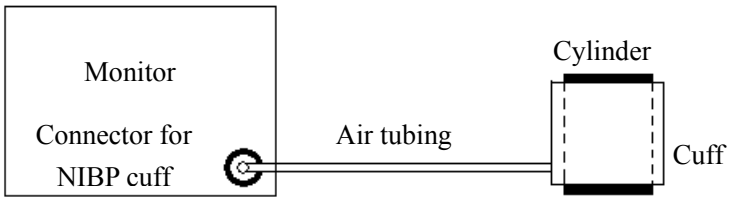
Tools required:

- An adult cuff

- An air tubing
- A correct sized cylinder

Follow this procedure to perform the leakage test:

1. Set the patient category to [**Adult**].
2. Connect the cuff to the NIBP connector on the monitor.
3. Wrap the cuff around the cylinder as shown below.



4. Select [**Main Menu**]→[**Maintenance >>**]→[**NIBP Leakage Test**]. The NIBP display shows [**Leakage Testing…**].
5. After about 20 seconds, the monitor will automatically deflate. This means the test is completed.
6. If the message [**NIBP Pneumatic Leak**] is displayed, it indicates that the NIBP airway may have leakages. Check the tubing and connections for leakages. If you ensure that the tubing and connections are all correct, perform a leakage test again.

If the problem persists, contact your service personnel.

NOTE

- **The leakage test is intended for use to simply determine whether there are leakages in the NIBP airway. It is not the same as that specified in the EN 1060-1 standard.**

9.11 NIBP Accuracy Test

The NIBP accuracy test is required once every two years or when you doubt the measured NIBP.

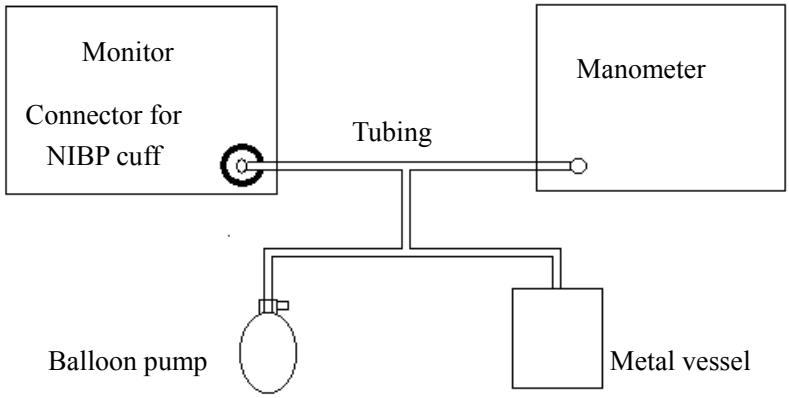
Tools required:

- T-piece connector
- Approprating tubing
- Balloon pump

- Metal Vessel (volume 500±25 ml)
- Reference manometer (calibrated with accuracy higher than 1 mmHg)

Follow this procedure to perform the accuracy test:

1. Connect the equipment as shown.



2. Before inflation, the reading of the manometer should be 0. If not, disconnect the airway and reconnect it unit the readings is 0.
3. Select [**Main Menu**]→[**Maintenance >>**]→[**NIBP Accuracy Test**].
4. Compare the manometer values with the displayed values. The difference between the manometer and displayed values should be no greater than 3 mmHg.
5. Raise the pressure in the metal vessel to 50 mmHg with the balloon pump. Repeat step 3 and 4.
6. Raise the pressure in the metal vessel to 200 mmHg with the balloon pump. Repeat step 3 and 4.

If the difference between the manometer and displayed values is greater than 3 mmHg, contact your service personnel.

9.12 Calibrating NIBP

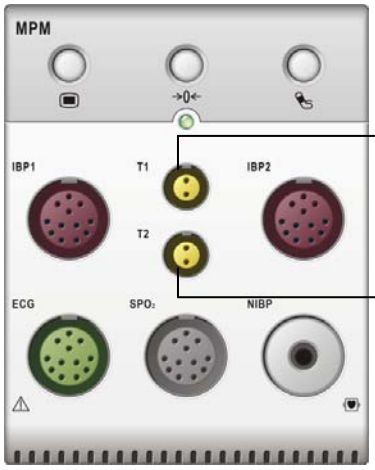
NIBP is not user-calibrated. Cuff-pressure transducers must be verified and calibrated at least once a year by a qualified service professional. Contact your service personnel when a calibration is necessary.

FOR YOUR NOTES

10 Monitoring Temp

10.1 Introduction

You can simultaneously monitor two temperature sites using the MPM. The monitor can automatically identify the temperature probe type.



10.2 Safety

⚠ WARNING

- **Verify that the probe detection program works correctly before monitoring. Plug out the temperature probe cable from the T1 or T2 connector, and the monitor can display the message [T1 Sensor Off] or [T2 Sensor Off] and give alarm tones correctly.**
- **The temperature measurement functioning should be calibrated every two years, or as indicated by your standard hospital procedure.**

10.3 Making a Temp Measurement

1. Select an appropriate probe for your patient.
2. If you are using a disposable probe, connect the probe to the temperature cable.
3 Plug the probe or temperature cable to the temperature connector.
4. Attach the probe to the patient correctly.
5. Check that the alarm settings are appropriate for this patient.

10.4 Understanding the Temp Display

The Temp Monitoring is displayed on the monitor as three numerics: T1, T2 and TD. By selecting this area, you can enter the [**Temp Setup**].

10.5 Setting the Temperature Unit

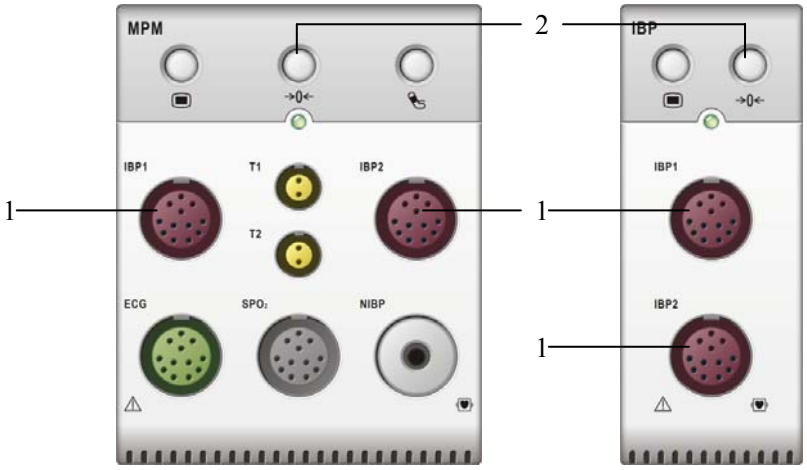
In the [**Temp Setup]** menu, select [**Unit]** and toggle between [**ºC**] and [**ºF**]

.

11 Monitoring IBP

11.1 Introduction

You can measure invasive blood pressure using the MPM, or the pressure plug-in module. The monitor can monitor up to 8 invasive blood pressures and displays the systolic, diastolic and mean pressures and a waveform for each pressure.



1. Connector for IBP cable 2. Zero key

11.2 Safety

⚠ WARNING

- **Use only pressure transducers specified in this manual. Never reuse disposable pressure transducers.**
- **Make sure that the applied parts never come into contact with other electric devices.**
- **To reduce the hazard of burns during high-frequency surgical procedure, ensure that the monitor's cables and transducers never come into contact with the high-frequency surgical units.**

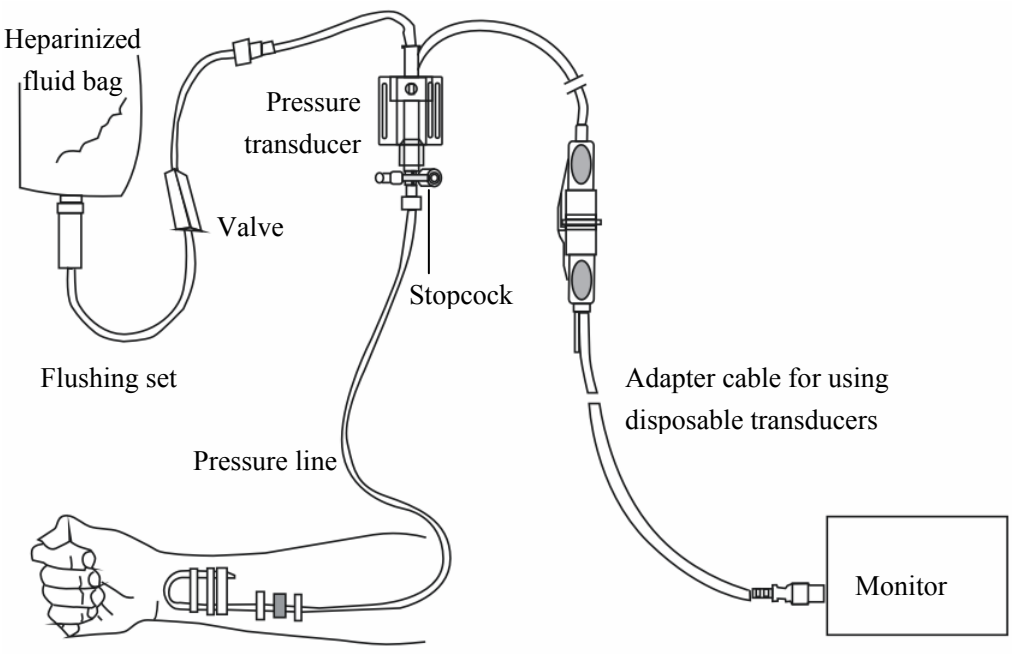
11.3 Setting Up the Pressure Measurement

1. Plug the pressure cable into the IBP connector.
2. Prepare the flush solution.
3. Flush the system to exhaust all air from the tubing. Ensure that the transducer and stopcocks are free of air bubbles.

⚠ WARNING

- **If air bubbles appear in the tubing system, flush the system with the infusion solution again. Air bubble may lead to wrong pressure reading.**

4. Connect the pressure line to the patient catheter.
5. Position the transducer so that it is level with the heart, approximately at the level of the midaxillary line.
6. Select the appropriate label.
7. Zero the transducer. After a successful zeroing, turn off the stopcock to the atmospheric pressure and turn on the stopcock to the patient.

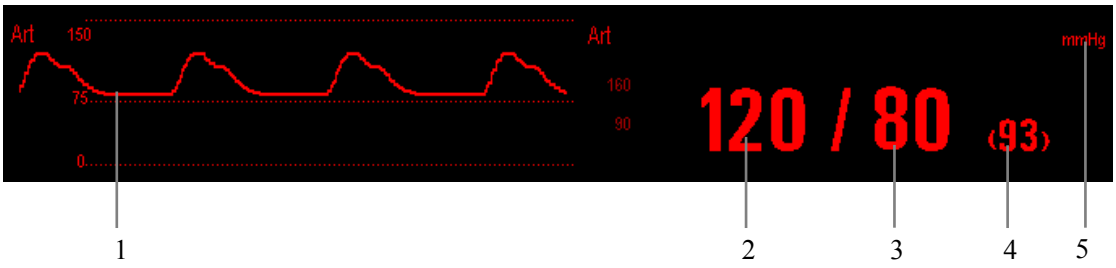


⚠ WARNING

- **If measuring intracranial pressure (ICP) with a sitting patient, level the transducer with the top of the patient's ear. Incorrect leveling may give incorrect values.**

11.4 Understanding the IBP Display

The IBP measurement is displayed on the monitor as a waveform and numeric pressures. The figure below shows the waveform and numerics for the Art pressure. For different pressures, this display may be slightly different.



1. Waveform
2. Systolic pressure
3. Diastolic pressure
4. Mean pressure
5. Pressure unit

For some pressures, the parameter window may show the mean pressure only. For different pressures, their default unit may be different. If the Art and ICP pressures are measured simultaneously, the parameter window of the ICP display will show numeric CPP, which is obtained by subtracting ICP from the Art mean.

11.5 Changing IBP Settings

11.5.1 Changing a Pressure for Monitoring

1. Select the pressure you want to change to enter its setup menu.
2. Select [**Label**] and then select your desired label from the list. The already displayed labels cannot be selected.

Label	Description	Label	Description
PA	Pulmonary artery pressure	CVP	Central venous pressure
Ao	Aortic pressure	LAP	Left arterial pressure
UAP	Umbilical arterial pressure	RAP	Right arterial pressure
BAP	Brachial arterial pressure	ICP	Intracranial pressure
FAP	Femoral artery pressure	UVP	Umbilical venous pressure
Art	Arterial blood pressure	P1 to P8	Non-specific pressure label
Custom labels		User-defined pressure labels	

11.5.2 Defining Pressure Labels

You can define up to 8 IBP labels. Your defined labels cannot be identical with the parameter names or pressure labels already exited in the system.

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Define IBP Labels >>**].
2. Select, in turn, the [**Label 1**] [**Label 2**]… [**Label 8**] as necessary and then enter names.

NOTE

- **Custom labels consist of up to 4 letters and/or numerics.**

11.5.3 Choosing the Pressure Alarm Source

You can monitor for alarm conditions in systolic, diastolic and mean pressure, either singly or in parallel. In the [**IBP Setup**], select [**Alm Source]** and choose from:

- [**Sys]**: alarms are given only when the systolic pressure violates the alarm limits.

- [**Dia**]: alarms are given only when the diastolic pressure violates the alarm limits.
- [**Mean**]: alarms are given only when the mean pressure violates the alarm limits.
- [**Sys&Mean**]: alarms are given when the systolic or mean pressure violates the alarm limits.
- [**Mean&Dia**]: alarms are given when the mean or diastolic pressure violates the alarm limits.
- [**Sys&Dia**]: alarms are given when the systolic or diastolic pressure violates the alarm limits.
- [**All**]: alarms are given when the systolic or mean or diastolic pressure violates the alarm limits.

11.5.4 Setting the Pressure Unit

In the setup menu for the pressure, select [**Unit**] and toggle between [**mmHg**], [**cmH2O**] and [**kPa**].

11.5.5 Setting Up the IBP Wave

In the waveform menu for the pressure, you can:

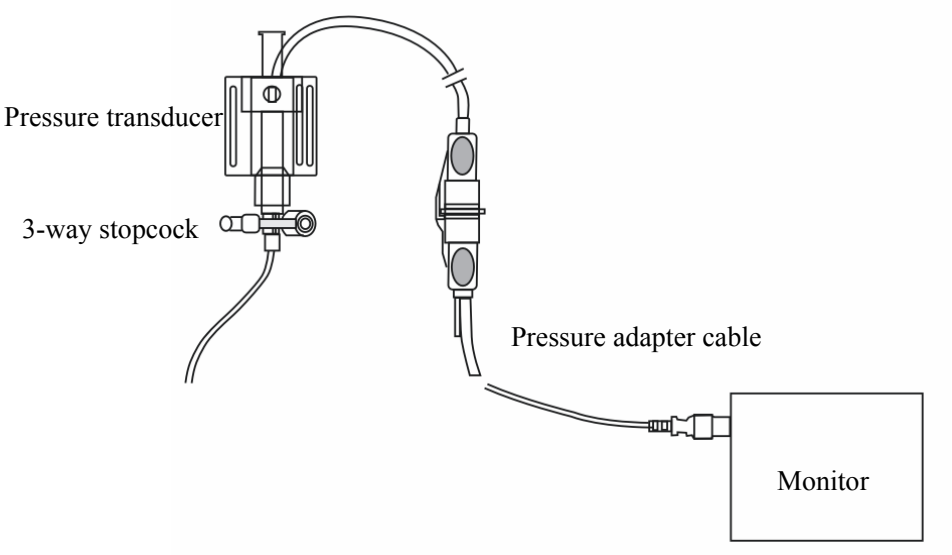
- Select [**Sweep**] and then select the appropriate setting. The faster the wave sweeps, the wider the wave is.
- Change the size of the pressure's waveform by adjusting [**Upper Scale**], [**Middle Scale**] or [**Lower Scale**].

11.6 Zeroing the Transducer

To avoid inaccurate pressure readings, the monitor requires a valid zero. Zero the transducer in accordance with your hospital policy (at least once per day). Zero whenever:

- A new transducer or adapter cable is used.
- You reconnect the transducer cable to the monitor.
- The monitor restarts.
- You doubt the readings.

1. Turn off the stopcock to the patient.



2. Vent the transducer to atmospheric pressure by turning on the stopcock to the air.
3. Press the →0← hardkey on the module, or, in the setup menu for the pressure (e.g. Art), select [**Art Zero** >>]→[**Zero**]. During zero calibration, the [**Zero**] button appears dimmed. It recovers after the zero calibration is completed.
4. After the zero calibration is completed, close the stopcock to the air and open the stopcock to the patient.

NOTE

- **Your hospital policy may recommend that the ICP transducer is zeroed less frequently than other transducers.**

11.7 Making the Pressure Calibration

⚠ WARNING

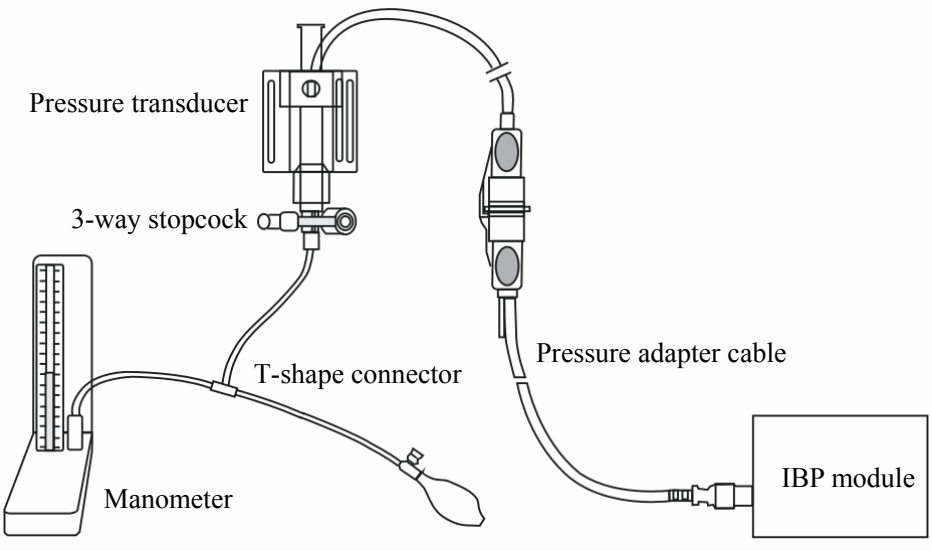
- **Never perform the invasive pressure calibration while a patient is being monitored.**

A calibration ensures accurate pressure readings. Perform a calibration when you use a new transducer, and at regular intervals according to your hospital policy. You require:

- Standard sphygmomanometer
- Balloon pump
- Tubing
- T-shape connector

Follow this procedure to perform the pressure calibration:

1. Disconnect the pressure transducer from the patient. Connect the 3-way stopcock, the sphygmomanometer and the balloon pump through a T-shape connector, as shown below.
2. Zero the transducer. After a successful zero, open the stopcock to the manometer.



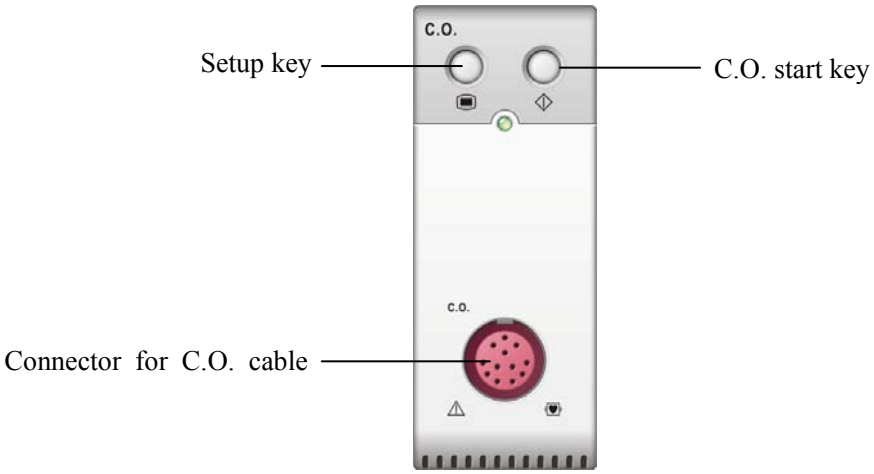
3. Select [**Main Menu**]→[**Maintenance** >>]→[**Cal**. **IBP Press.** >>]. In the [**Cal. IBP Press.**] menu, enter calibration values for calibrated pressures.
4. Inflate using the balloon pump until the mercury in the manometer reaches to the preset calibration pressure value.
5. Adjust the preset calibration value until it equals to the reading on the manometer.
6. Select the [**Calibrate**] button to the right of the calibrated pressure. The monitor starts a calibration.
7. When the calibration is completed, the message [**Calibration Completed!**] is displayed. If the calibration failed, a prompt message will be displayed.
8. After the calibration is completed, disconnect the blood pressure tubing and the T-shape connector.

FOR YOUR NOTES

12 Monitoring Cardiac Output

12.1 Introduction

The cardiac output (C.O.) measurement invasively measures cardiac output and other hemodynamic parameters using the right heart (atria) thermodilution method. A cold solution of known volume and temperature is injected into the right atrium through the proximal port of a pulmonary artery (PA) catheter. The cold solution mixes with the blood in the right ventricle and the change in blood temperature is measured with a thermistor at the distal end of the catheter in the pulmonary artery. The temperature change is displayed as a curve in the C.O. split screen, and the monitor calculates the C.O. value from this curve. The C.O. value is inversely proportional to the area under the curve. As cardiac output varies continuously, a series of measurements must be carried out to achieve a reliable C.O. average value. Always use the average of multiple thermodilution measurements for therapy decisions. The monitor is capable of storing 6 measurements.



12.2 Understanding the C.O. Display

The C.O. measurement is displayed on the monitor as numeric C.O. and BT in the C.O. parameter window as shown below. To enter the [**C.O. Setup**] menu, select the C.O. parameter window.

1. Temperature unit 2. Blood temperature 3. Cardiac output

12.3 Influencing Factors

Some of the factors which affect cardiac output are:

- temperature of injectate solution,
- volume of injectate solution,
- patient's baseline blood temperature,
- patient's inspiratory/expiratory cycle,
- placement of catheter with relation to proximity of lung field,
- the catheter itself,
- the patient rhythm and hemodynamic status, and
- any other rapid IV solutions which are infused while the C.O. measurement is being performed.

Followings are some technique suggestions to obtain accurate C.O.:

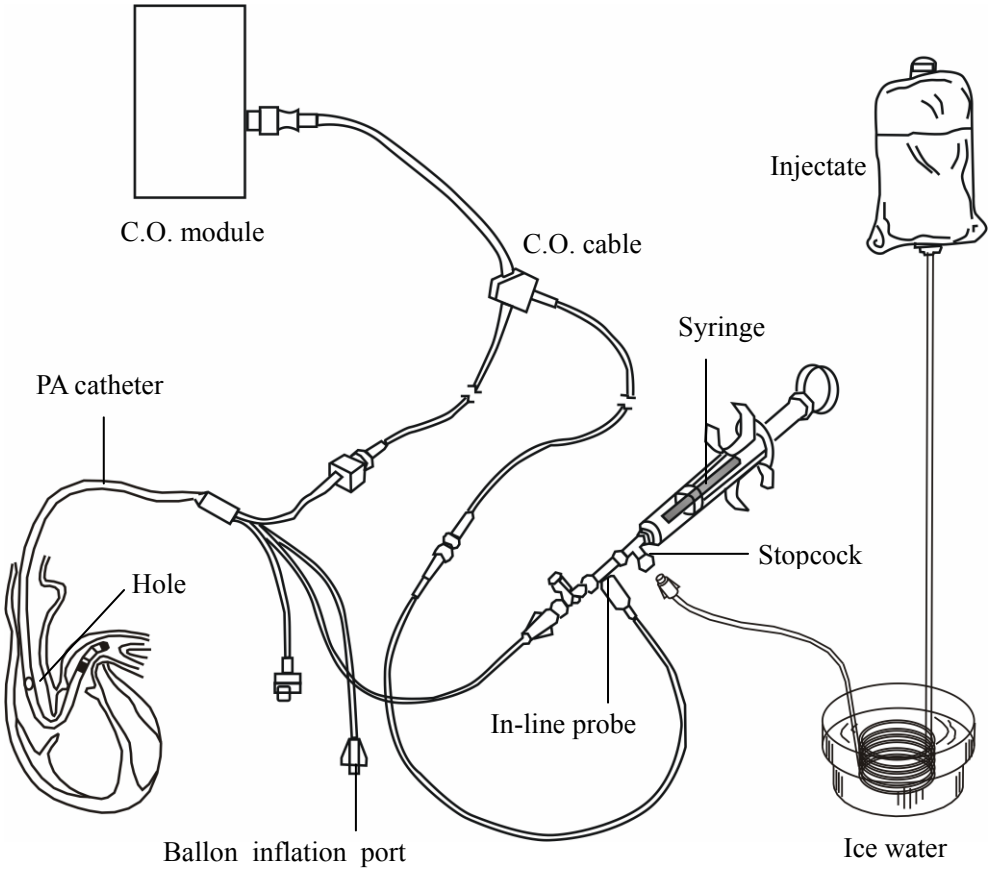
- Injectate solution must be cooler than the patient's blood.
- Inject solution rapidly and smoothly.
- Inject at end expiration.
- Wait 1 minute between injections to allow baseline to stabilized.

12.4 Setting Up the C.O. Measurement

⚠WARNING

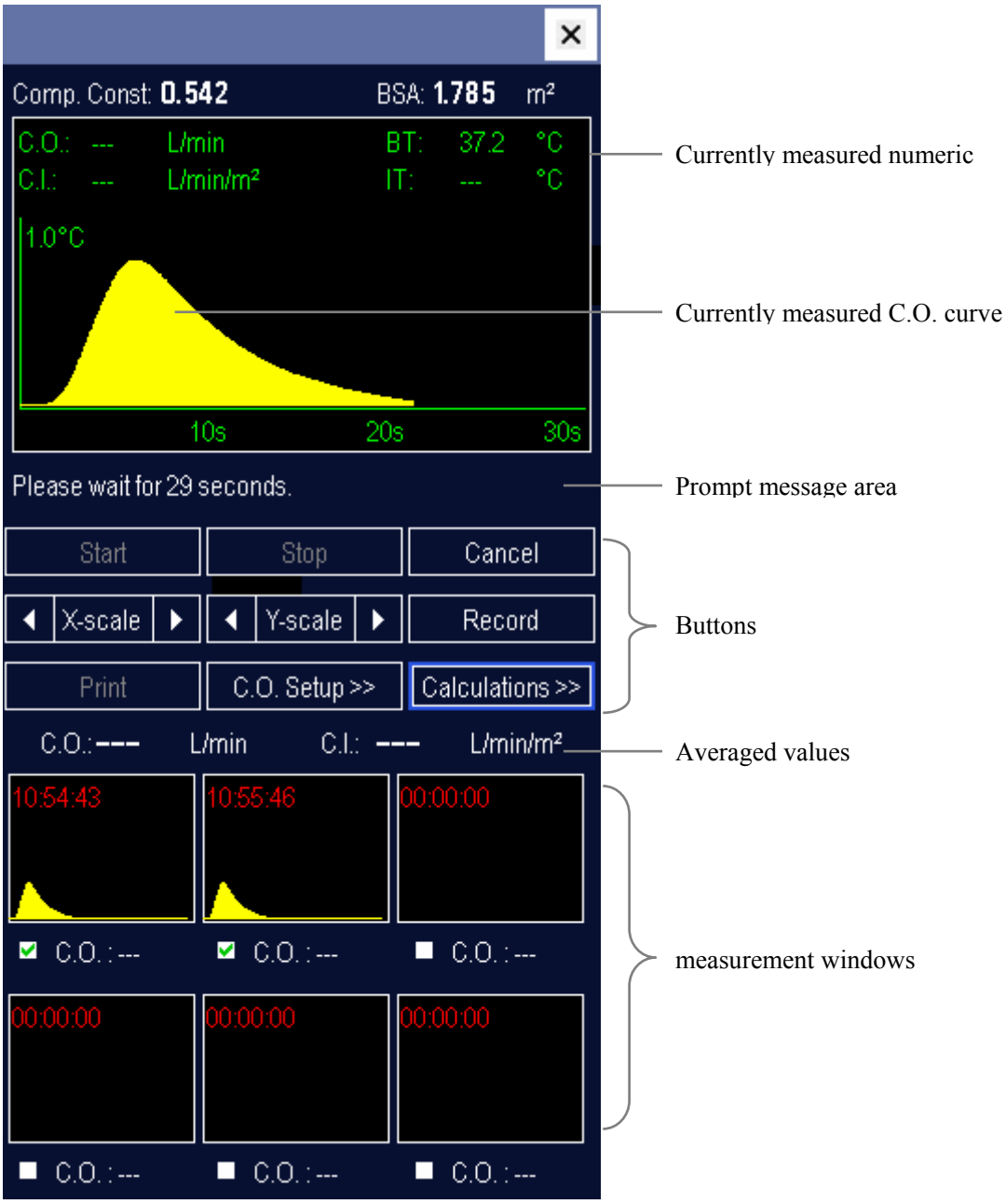
- **Use only accessories specified in this manual. Make sure that the accessories never come into contact with conductive parts.**

1. Connect the C.O. cable to the C.O. connector on the monitor.
2. Interconnect the C.O. module, catheter and syringe as shown below. Make sure that:
   - The module is securely inserted.
   - The PA catheter is in place in the patient.
   - The C.O. cable is properly connected to the module.



3. Check if the height and weight are appropriate for your patient in the [**Patient Demographics**] menu. Change if necessary.

4. Select the C.O. parameter window to enter the [**C.O. Setup**] menu. In the [**C.O. Setup**] menu:
   - Check that the correct computation constant is entered. To change the computation constant, select [**Comp. Const**] and then enter the correct value. When a new catheter is used, the computation constant should be adjusted in accordance with the manufacturer's instructions for use.
   - Switch [**Auto IT**] on and the injectate temperature is automatically obtained.
   - When [**Auto IT**]] is switched off, you can enter the injectate temperature in the [**Manual IT**] field.
5. Select [**C.O. Measure**] to enter the C.O. measurements window.



6. When you see the message [**Ready for New Measurement**], select the [**Start**] button and then inject the solution within 4 seconds. As shown in the figure above, during the measurement, the currently measured thermodilution curve is displayed on the upper part. At the end of the measurement, the thermodilution curve is transferred to one of the 6 measurement windows on the lower part and the monitor prompts you to wait for a certain period of time before starting a new measurement.
7. When you see the message [**Ready for New Measurement**], repeat step 5 until you have completed the measurements you want to perform. A maximum of 6 measurements can be stored. If you perform more than six measurements without rejecting any, the oldest will automatically be deleted when a seventh curve is stored. Select from the 6 measurement curves and the system will automatically calculate and display the averaged C.O. and C.I. values.

When injecting, the stopcock to the PA catheter is open and the stopcock to the injectate solution is closed. After the measurement is completed, turn off the stopcock to the PA catheter and turn on the stopcock to the injectate solution, and then draw the injectate solution into the injectate syringe.

In the buttons area, you can:

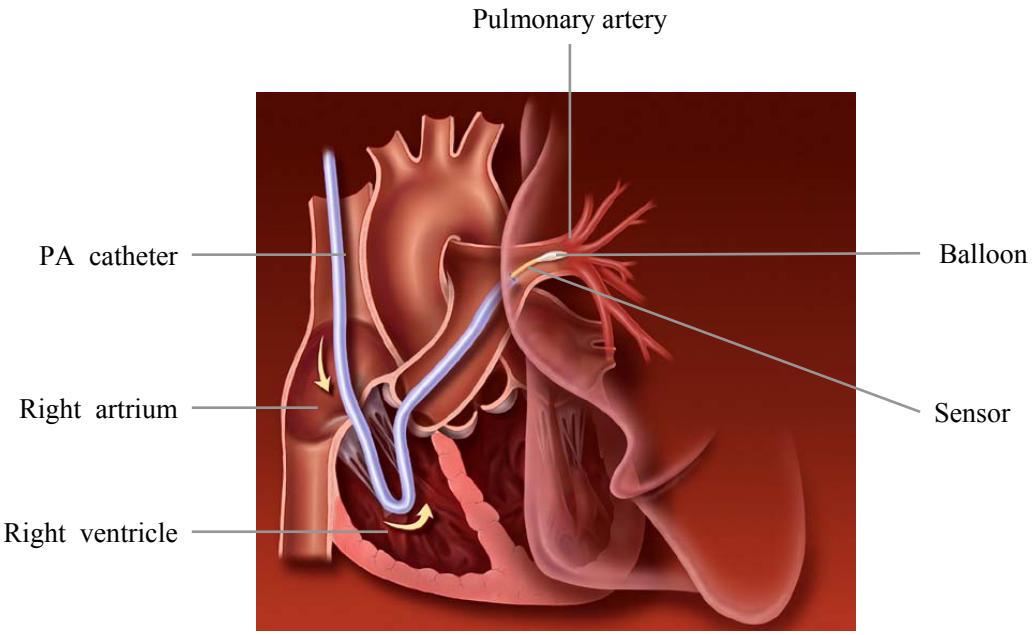
- Select [**Start**] to start a C.O. measurement.
- Select **Stop**] to stop the current measurement.
- Select [**Cancel**] during a measurement to cancel the measurement. Selecting it after a measurement deletes the measured results.
- Select [**X-Scale**] to adjust the scale of the X-axis. Options for scale range are 30 s and 60 s.
- Select [**Y-Scale**] to adjust the scale of the Y-axis. Options for scale range are 0.5ºC, 1ºC and 2.0ºC.
- Select [**Record**] to print out the most recently-measured curve and numerics by the recorder.
- Select [**C.O. Setup >>**] to access the [**C.O. Setup**] menu.
- Select [**Calculations >>**] to access the [**Hemodynamic Calculation**] menu.

NOTE

- **During the cardiac output measurement, blood temperature alarms are inactive.**

12.5 Measuring the Blood Temperature

As shown below, the blood temperature is measured with a temperature sensor at the distal end of the catheter in the pulmonary artery. During C.O. measurements, blood temperature alarms are suppressed to avoid false alarms. They will automatically recover as soon as the C.O. measurements are completed.



12.6 Changing C.O. Settings

12.6.1 Setting the Temperature Unit

In the [**C.O. Setup**] menu, select [**Temp Unit**] to toggle between [**ºC**] and [**ºF**].

12.6.2 Setting the Interval between Measurements

To avoid inaccurate measurements, a certain period of time should be allowed for the blood temperature to become stable before starting a new measurement. To set the interval between two measurements, in the [**C.O. Setup**] menu, select [**Interval (s)**] and enter an appropriate value. Every time when a measurement is completed, the monitor will count down the remaining time and give corresponding prompt messages.

13 Monitoring Carbon Dioxide

13.1 Introduction

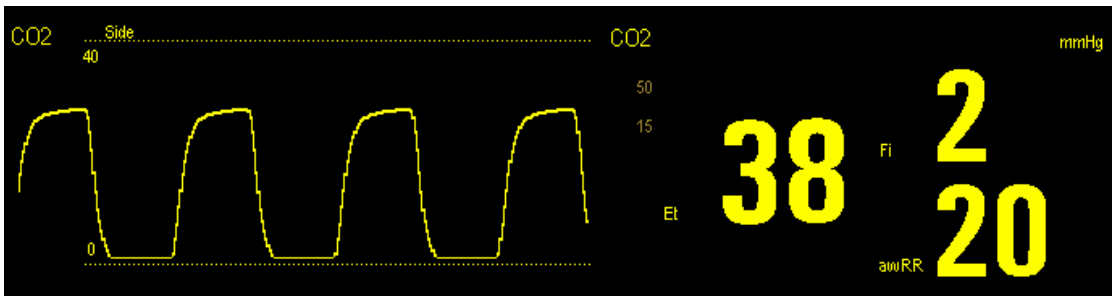
CO_2 monitoring is a continuous, non-invasive technique for determining the concentration of CO_2 in the patient' airway by measuring the absorption of infrared (IR) light of specific wavelengths. The CO_2 has its own absorption characteristic and the amount of light passing the gas probe depends on the concentration of the measured CO_2. When a specific band of IR light is passed through respiratory gas samples, some of IR light will be absorbed by the CO_2 molecules. The amount of IR light transmitted after it has been passed through the respiratory gas sample is measured with a photodetector. From the amount of IR light measured, the concentration of CO_2 is calculated.

There are two methods for measuring CO_2 in the patient's airway:

1. Mainstream measurement uses a CO_2 sensor attached to an airway adapter directly inserted into the patient's breathing system.
2. Sidestream/Microstream measurement samples expired patient gas at a constant sample flow from the patient's airway and analyzes it with a CO_2 sensor built into the CO_2 module.

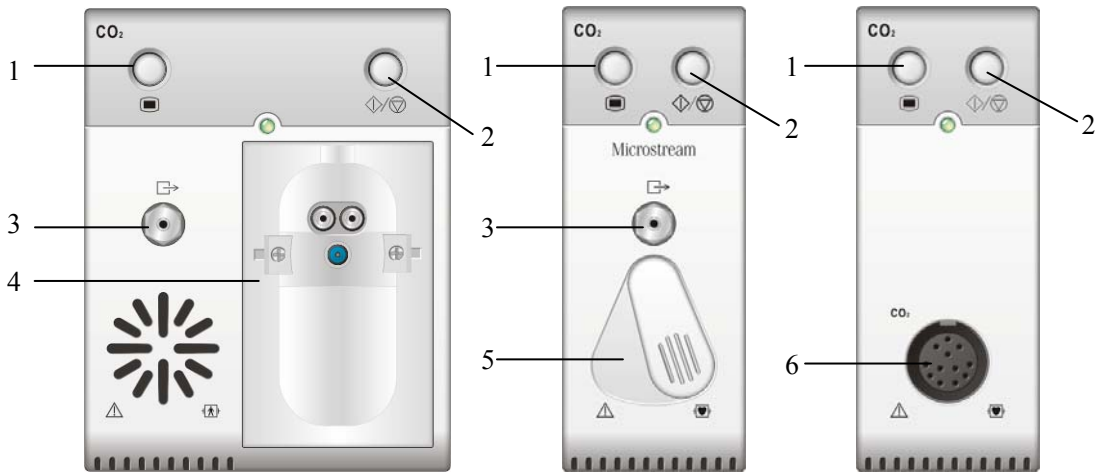
The measurement provides:

1. A CO_2 waveform
2. End tidal CO_2 value ($EtCO_2$): the CO_2 value measured at the end of the expiration phase.
3. Fraction of inspired CO_2 ($FiCO_2$): the CO_2 value measured during inspiration.
4. Airway respiration rate (awRR): the number of breaths per minute, calculated from the CO_2 waveform.



13.2 Identifying CO_2 Modules

From left to right are sidestream CO_2 module, microstream CO_2 module and mainstream CO_2.



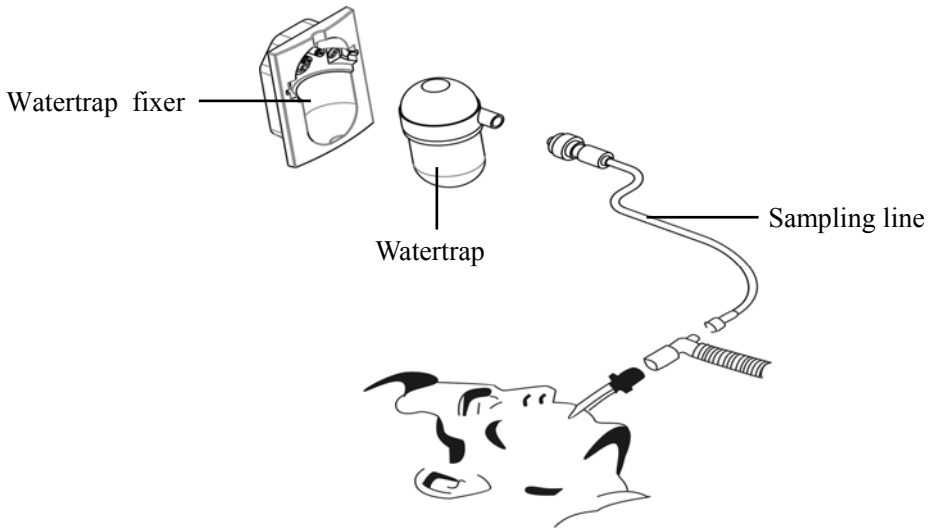
1. Setup key to enter the CO_2 setup menu
2. Measure/standby
3. Gas outlet
4. Slot for CO_2 watertrap
5. Connector for sampling line
6. Connector for CO_2 transducer

If you measure CO_2 using the AG module, see the section ***Monitoring AG***.

13.3 Preparing to Measure CO_2

13.3.1 Using a Sidestream CO_2 Module

1. Attach the watertrap to the module and then connect the CO_2 components as shown below.



2. By default, the sidestream CO_2 module is in standby mode. The [**CO_2 Standby**] message appears on the screen when the CO_2 module is plugged. To set the CO_2 module to measure mode, Select the ◇/▽ hardkey on the module to switch to the [**Measure**] mode, or select the CO_2 parameter window→[**Operating Mode**]→[**Measure**]. The message [**CO2 Startup**] is displayed.
3. After start-up is finished, the CO_2 module needs time to warm up to reach the operating temperature. The message [**CO_2 Sensor Warmup**] is displayed. If you perform CO_2 measurements during warm-up, the measurement accuracy may be compromised.
4. After warm-up is finished, you can perform CO_2 measurements.

NOTE

- **To extend the lifetime of the watertrap and module, disconnect the watertrap and set the operating mode to standby mode when CO_2 monitoring is not required.**

⚠CAUTION

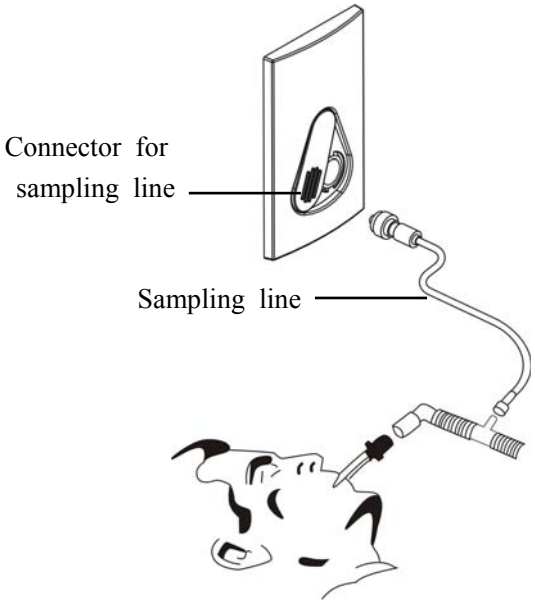
- **The watertrap collects water drops condensed in the sampling line and therefore**

prevents them from entering the module. If the collected water reaches to a certain amount, you should drain it to avoid blocking the airway.

- **The watertrap has a filter preventing bacterium, water and secretions from entering the module. After a long-term use, dust or other substances may compromise the performance of the filter or even block the airway. In this case, replace the watertrap. Replacing the watertrap once a month is recommended.**

13.3.2 Using a Microstream CO_2 Module

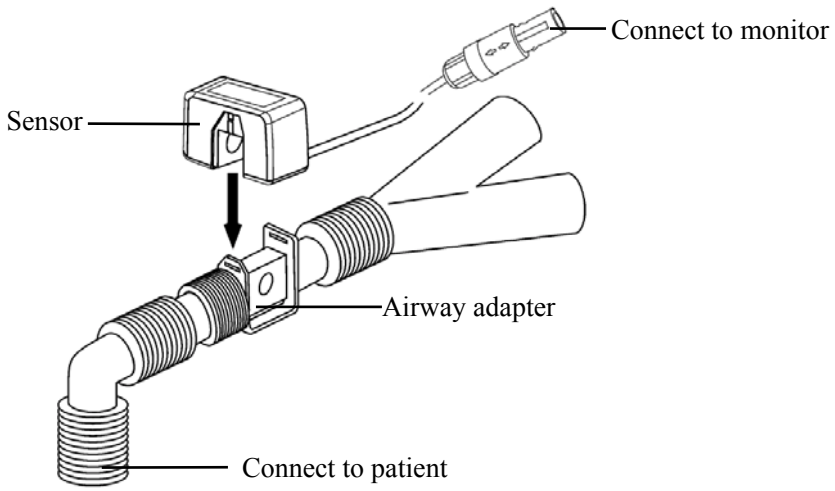
1. Connect the sampling line to the module and then connect the CO_2 components as shown below.



2. By default, the microstream CO_2 module is in measure mode. The message [**CO2 Sensor Warmup**] appears on the screen when the CO_2 module is plugged.
3. After warm-up, you can perform CO_2 measurements.

13.3.3 Using a Mainstream CO_2 Module

1. Connect the sensor to the module.
2. By default, the mainstream CO_2 module is in standby mode. The message [**CO2 Standby**] appears on the screen when the CO_2 module is plugged. To set CO_2 module to measure mode, select the ◇/▽ hardkey on the module to switch to the [**Measure**] mode, or select the CO_2 parameter window→[**Operating Mode**]→[**Measure**]. The message [**CO2 Sensor Warmup**] is displayed.
3. After warm-up is finished, connect the transducer to the airway adapter.
4. Perform a zero calibration per the ***Zeroing the Sensor*** section.
5. After the zero calibration is finished, connect the airway as shown below.



5. Make sure there are no leakages in the airway and then start a measurement.

NOTE

- **Always position the sensor with the adapter in an upright position to avoid collection of fluids on the windows of the adapter. Large concentrations of fluids at this point will obstruct gas analysis.**

13.4 Changing CO_2 Settings

13.4.1 Accessing CO_2 Menus

- By selecting the CO_2 parameter window, you can access the [**CO2 Setup**] menu.
- By selecting the CO_2 waveform, you can access the [**CO2 Waveform**] menu.

13.4.2 Changing the Operating Mode

For sidestream or microstream CO_2 modules, the default operating mode is standby when the monitor is switched on. You can start the CO_2 module by selecting the ⏀/▽ hardkey, or the CO_2 parameter window→[**Operating Mode**]→[**Measure**]. When the monitor restarts, the CO_2 module automatically continues with the previously chosen operating mode.

During standby, the CO_2 gas sample intake pump, infrared light, etc. are automatically switched off to extend the lifetime of the CO_2 module.

13.4.3 Setting the Pressure Unit

In the [**CO2 Setup**] menu, select [**Press. Unit**] and toggle between [**mmHg**], [**%**] and [**kPa**].

13.4.4 Setting up CO_2 Compensations

⚠WARNING

- **Make sure that the appropriate compensations are used. Inappropriate compensations may cause inaccurate measurement values and result in misdiagnosis.**

For the sidestream CO_2 module, in the [**CO2 Setup**] menu, respectively select:

- [**O2 Compen**] and toggle between [**On**] and [**Off**]. When the amount of O_2 in the ventilation gas mixture is greater than 50%, you'd better switch this compensation on.
- [**N2O Compen**] and toggle between [**On**] and [**Off**]. When the amount of N_2O in the ventilation gas mixture is greater than 30%, you'd better switch this compensation on.
- [**Des Compen**] and toggle between [**On**] and [**Off**]. If desflurane is present in the ventilation gas mixture, you'd better switch this compensation on.

For the microstream CO_2 module, gas compensations are not required.

For the mainstream CO_2 module, in the [**CO2 Setup**] menu, respectively select:

- [**Balance Gas**] and toggle between [**Room Air**] and [**N2O**]. Select [**Room Air**] when air predominates in the ventilation gas mixture and select [**N2O**] when N_2O predominates in the ventilation gas mixture.
- [**O2 Compen**] and then select [**Off**] or an appropriate setting according to the amount of O_2 in the ventilation gas mixture. When the amount of O_2 is less than 30%, you'd better switch this compensation off.
- [**AG Compen**] and enter the concentration of anesthetic gas present in the ventilation gas mixture. This could compensate for the effect of AG on the readings.

13.4.5 Humidity Compensation for Side/Microstream CO_2 Readings

Sidestream and microstream CO_2 modules are configured to compensate CO_2 readings for either Body Temperature and Pressure, Saturated Gas (BTPS), to account for humidity in the patient's breath, or Ambient Temperature and Pressure, Dry Gas (ATPD).

1. In the [**CO2 Setup**] menu, select [**Humidity Compen**].

2. Select either [**Wet**] for BTPS or [**Dry**] for ATPD, depending on which compensation applies.

For CO_2, the humidity compensation can be set to [**Wet**] or **[Dry**]:

1. Dry: $P_{co2}(mmHg) = CO_2(vol\%) \times P_{amb} / 100$

2. Wet: $P_{CO2}(mmHg) = CO_2(vol\%) \times (P_{amb} - 47) / 100$

where, P_{CO2} = partial pressure, $vol\%$ = CO_2 concentration, P_{amb} = ambient pressure, and unit is mmHg.

13.4.6 Setting the Apnea Alarm Delay

In the [**CO2 Setup**] menu, select [**Adjust CO2 Limits >>**]→[**Apnea Time**] and then select the appropriate setting. The monitor will alarm if the patient has stopped breathing for longer than the preset apnea time.

13.4.7 Choosing a Time Interval for Peak-Picking

For microstream and mainstream CO_2 modules, you can select a time interval for picking the highest CO_2 as the $EtCO_2$ and the lowest as the $FiCO_2$.

In the [**CO2 Setup**] menu, select [**Max Hold**] and toggle between [**Single Breath**], [**10 s**], [**20 s**] and [**30 s**].

- [**Single Breath**]: $EtCO_2$ and $FiCO_2$ are calculated for every breath.
- [**10 s**], [**20 s**] or [**30 s**]: $EtCO_2$ and $FiCO_2$ are calculated using 10, 20 or 30 seconds of data.

13.4.8 Setting up the CO_2 Wave

In the [**CO2 Waveform**] menu, you can:

- Select [**Wave Type**] and toggle between [**Draw**] and [**Fill**]:
  - [**Draw**]: The CO_2 wave is displayed as a curved line.
  - [**Fill**]: The CO_2 wave CO_2 is displayed as a filled area.

- Select [**Sweep**] and the select the appropriate setting. The faster the wave sweeps, the wider the wave is.
- Change the size of the CO_2 waveform by adjusting the wave **[Scale**].

13.4.9 Setting the Automatic Standby Time

For the microstream CO_2 module, you can set a period of time after which the CO_2 module enters the standby mode if no patient breath is detected. To set the standby time, in the [**CO2 Setup**] menu, select [**Auto Standby (min)**] and then select the appropriate setting.

13.5 Troubleshooting the Sidestream CO_2 Sampling System

When the sampling system of the sidestream CO_2 module works incorrectly, check if the sampling line is kinked. If not, remove it from the watertrap. If the monitor gives a message indicating the airway still works incorrectly, it indicates that the watertrap must have been blocked, and you should replace with a new one. Otherwise, you can determine that the sampling line must have been blocked. Replace with a new sampling line.

13.6 Removing Exhaust Gases from the System

⚠WARNING

- **Anesthetics: When using the Sidestream or Microstream CO_2 measurement on patients who are receiving or have recently received anesthetics, connect the outlet to a scavenging system, or to the anesthesia machine/ventilator, to avoid exposing medical staff to anesthetics.**

To remove the sample gas to a scavenging system, connect an exhaust tube to the gas outlet connector of the module.

13.7 Zeroing the Sensor

The zero calibration eliminates the effect of baseline drift during CO_2 measurement exerted on the readings and therefore maintains the accuracy of the CO_2 measurements.

13.7.1 For Sidestream and Microstream CO_2 Modules

For sidestream and microstream CO_2 modules, a zero calibration is carried out automatically when necessary. You can also start a manual zero calibration if necessary. To manually start a zero calibration, select [**Start Zero Cal.**] in the [**CO2 Setup**] menu. Disconnecting the patient airway is not required when performing a zero calibration.

13.7.2 For Mainstream CO_2 Modules

For mainstream CO_2 modules, zero the sensor whenever:

- A new adapter is used;
- You reconnect the sensor to the module;
- You see the message [**CO2 Zero Required**]. In this case, check the airway adapter for any blockage, e.g. mucus, etc. If a blockage is detected, clear or replace the adapter.

To zero the sensor, follow this procedure:

1. Connect the sensor to the module.
2. In the [**CO2 Setup**] menu, set the [**Operating Mode**] to [**Measure**]. The message [**CO2 Sensor Warmup**] is displayed.
3. After warm-up is finished, connect the sensor to a clean, dry airway adapter. The adapter should be vent to the air and isolated from CO_2 sources, such as ventilator, the patient's breathing, your own breathing, etc.
4. Select [**Start Zero Cal.**] in the [**CO2 Setup**] menu. The message [**CO2 Zero Running**] is displayed.
5. It takes about 15 to 20 seconds. The message disappears when the zero calibration is completed.

⚠WARNING

- **When perform a zero calibration during the measurement, disconnect the transducer from the patient's airway first.**

13.8 Calibrating the Sensor

For sidestream or microstream CO_2 modules, a calibration should be performed once every year or when the readings go far beyond the range. For mainstream CO_2 modules, no calibration is required. For details, refer to the chapter ***25 Maintenance***.

13.9 Oridion Information

Microstream

This trademark is registered in Israel, Japan, German and America.

Oridion Patents

This device and the CO_2 sampling consumables designed for use herewith is covered by one or more of the following USA patents: 4,755,675; 5,300,859; 5,657,750; 5,857,461 and international equivalents. USA and international patents pending.

No Implied License

Possession or purchase of this device does not convey any express or implied license to use the device with unauthorized CO_2 sampling consumables which would, alone, or in combination with this device, fall within the scope of one or more of the patents relating to this device and/or CO_2 sampling consumable.

FOR YOUR NOTES

14 Monitoring AG

14.1 Introduction

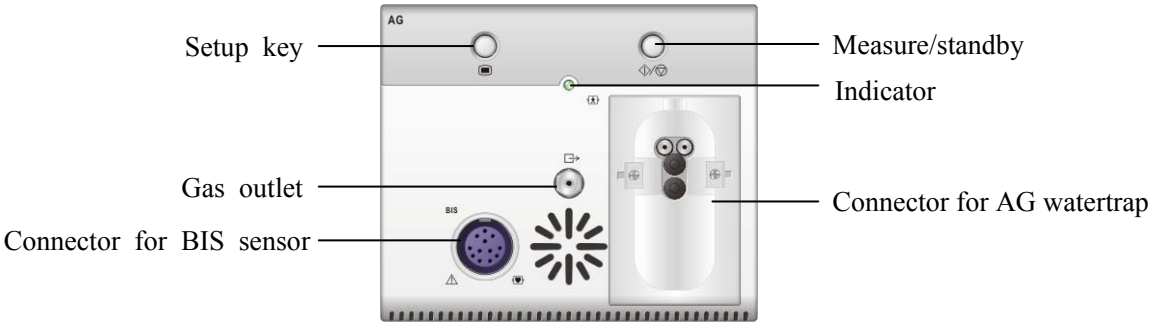
The anaesthetic gas (AG) module measures the patient's anesthetic and respiratory gases, and incorporates the features of the O_2 module and BIS module as well.

The AG module determines the concentration of certain gases using the infrared (IR) light absorption measurement. The gases that can be measured by the AG module absorb IR light. Each gas has its own absorption characteristic. The gas is transported into a sample cell, and an optical IR filter selects a specific band of IR light to pass through the gas. For multiple gas measurement, there are multiple IR filters. The higher the concentration of gas in a given volume the more IR light is absorbed. This means that higher concentration of IR absorbing gas cause a lower transmission of IR light. The amount of IR light transmitted after it has been passed though an IR absorbing gas is measured. From the amount of IR light measured, the concentration of gas present can be calculated.

Oxygen does not absorb IR light as other breathing gases and is therefore measured relying on its paramagnetic properties. Inside the O_2 sensor are two nitrogen-filled glass spheres mounted on a strong rare metal taut-band suspension. This assembly is suspended in a symmetrical non-uniform magnetic field. In the presence of paramagnetic oxygen, the glass spheres are pushed further away from the strongest part of the magnetic field. The strength of the torque acting on the suspension is proportional to the oxygen concentration. From the strength of the torque, the concentration of oxygen is calculated.

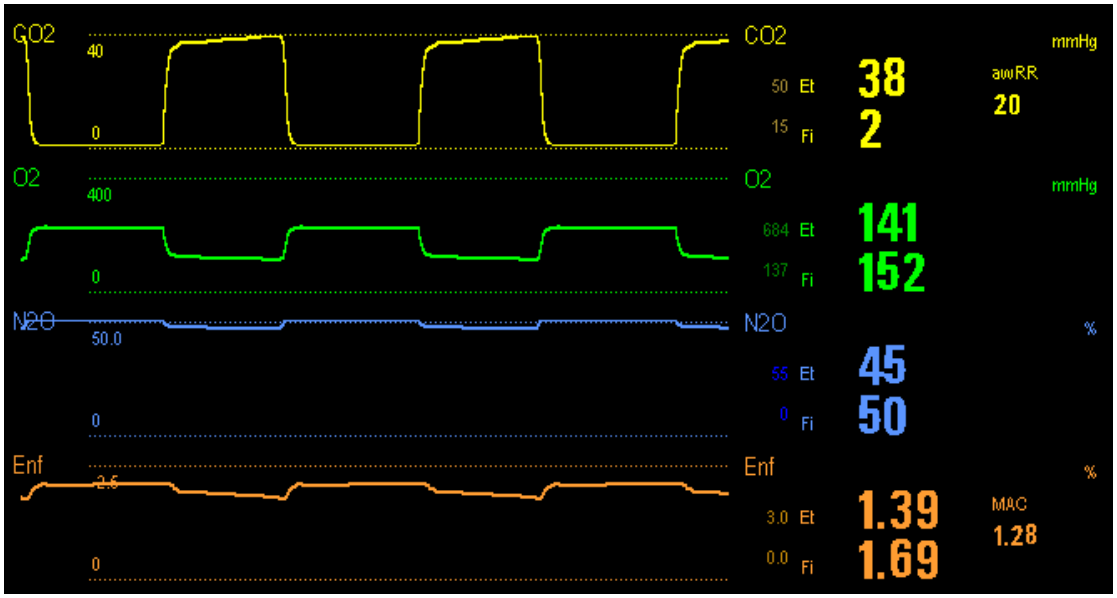
14.2 Identifying AG Modules

There are two AG modules: M-type and A-type. The M-type module cannot automatically identify anesthetic gases, but the A-type module can.



For details on BIS, refer to the chapter ***16 Monitoring BIS***.

14.3 Understanding the AG Display



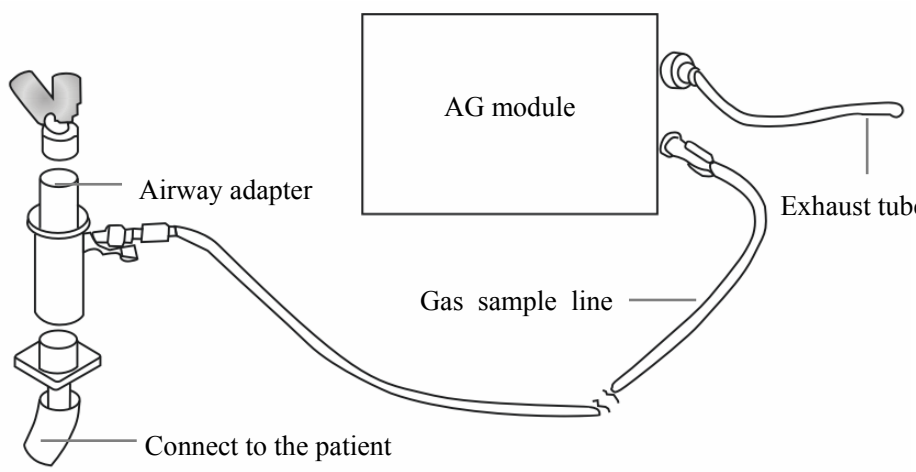
The AG module can send waves and numerics for all measured anesthetic gases for display on the monitor, including:

- CO_2, O_2, N_2O and AA waves
- awRR: airway respiratory rate
- MAC: minimal alveolar concentration
- End tidal (Et) and fraction of inspired (Fi) numerics for CO_2, O_2, N_2O and AA

Where AA represents Des (desflurane), Iso (isoflurane), Enf (enflurane), Sev (sevoflurane), or Hal (halothane).

14.4 Connecting AG Accessories

1. Select an appropriate watertrap according to patient category and attach it to the module.
2. Connect the gas sample line to the connector of the watertrap.
3. Connect the other end of the gas sampling line to the patient via the airway adapter.
4. Connect the gas outlet to a scavenging system using an exhaust tube.



⚠CAUTION

- **Position the airway adapter so that the part connecting to the gas sample line is pointing upwards. This prevents condensed water from passing into the gas sample line and causing an occlusion.**
- **The watertrap collects water drops condensed in the sampling line and therefore prevents them from entering the module. If the collected water reaches to a certain amount, you should drain it to avoid blocking the airway.**
- **The watertrap has a filter preventing bacterium, water and secretions from entering the module. After a long-term use, dust or other substances may compromise the performance of the filter or even block the airway. In this case, replace the watertrap. Replacing the watertrap once a month is recommended.**

⚠WARNING

- **Make sure that the connections are tight. Any leak in the system can result in erroneous readings due to ambient air mixing with patient gases.**
- **Do not apply adult watertrap to the neonate patient. Otherwise, patient injury could result.**

14.5 Changing AG Settings

14.5.1 Accessing AG Menus

- By selecting the CO_2, O_2 or N_2O parameter window, you can respectively access the [**CO2 Setup**], [**O2 Setup**] or [**NO2 Setup**] menu. By selecting the CO_2, O_2 or N_2O waveform area, you can respectively access the [**CO2 Waveform**], [**O2 Waveform**] or [**NO2 Waveform**] menu.
- For the M-type module, the parameter window and waveform area labeled with [**AA**] are displayed if no anesthetic agent is already selected. By selecting the parameter window or waveform area, you can access the [**AA Setup**] or [**AA Waveform**] menu.
- For the A-type module, the parameter window and waveform area with a specific anesthetic gas label are displayed. By selecting the parameter window or waveform area, you can access that gas's setup or waveform menu.

14.5.2 Selecting an Anesthetic Gas for Monitoring

As the M-type module cannot automatically identify 5 anesthetic gases, you need to select an anesthetic gas before use. To select the anesthetic gas, in the [**AA Setup**] menu, select [**Agent**] and then select the appropriate setting.

14.5.3 Setting the Apnea Alarm Delay

In the setup menu for any gas, select [**Apnea Time**] and select the appropriate setting. The monitor will alarm if the patient has stopped breathing for longer than the preset apnea time.

14.5.4 Changing the Sample Flow Rate

In the setup menu for any gas, select [**Flow Rate**] and then choose either:

- [**High**]: 200 ml/min for adult and pediatric patients, and 120 ml/min for neonatal patients.
- [**Med**]: 150 ml/min for adult and pediatric patients, and 90 ml/min for neonatal patients.
- [**Low**]: 120 ml/min for adult and pediatric patients, and 70 ml/min for neonatal patients.

14.5.5 Setting up the O_2 Compensation

If the AG module does not incorporate the O_2 module, you need to manually select [**O2 Compen**] and then select [**Off**] or an appropriate setting according to the amount of O_2 in the ventilation gas mixture. When the amount of O_2 is less than 30%, you'd better switch this compensation off.

If the AG module incorporates the O_2 module, the system will directly use the O_2 concentration detected by the O_2 module to make compensation. At this time, the [**O2 Compen**] in the setup menu for any gas is fixed to [**Off**].

14.5.6 Changing the Operating Mode

The default operating mode is standby when the monitor is switched on. You can start the AG module by selecting any gas's parameter window→[**Operating Mode**]→[**Measure**]. When the monitor restarts, the AG module automatically continues with the previously chosen operating mode.

14.5.7 Setting the Automatic Standby Time

The AG module enters standby mode automatically when no breath is detected for a configured period of time. Before the AG module enters the standby mode, at least one breath should be detected. Otherwise, it will not enter the standby mode even if the patient has stopped for longer than the configured period time. To set the standby time, in the setup menu for any gas, select [**Auto Standby**] and then select the appropriate setting.

14.5.8 Setting up the AG Wave

Select a gas's waveform area to enter its waveform menu. In this menu, you can:

- Select [**Wave Type**] and toggle between [**Draw**] and [**Fill**] (This option is for CO_2 only):
  - [**Draw**]: The CO_2 wave is displayed as a curved line.
  - [**Fill**]: The CO_2 wave CO_2 is displayed as a filled area.
- Select [**Sweep**] and then select the appropriate setting. The faster the wave sweeps, the wider the wave is.
- Change the size of the waveform by adjusting the [**Scale**].

14.6 Troubleshooting

14.6.1 When the Gas Inlet is Blocked

If the gas inlet (including watertrap, sampling line and airway adapter) is occluded by condensed water, the message [**AG Airway Occluded**] will appears.

To remove the occlusion:

- Check the airway adapter for an occlusion and replace if necessary.
- Check the sampling line for an occlusion or kinking and replace if necessary.
- Check the watertrap for a build up of water. Empty the watertrap. If the problem persists, replace the watertrap.

14.6.2 When Internal Occlusions Occurs

Condensed water may enter the module and cause contamination and/or internal occlusions. In this case, the message [**AG Airway Occluded**] will be displayed.

To remove the occlusion:

- Check for any occlusion in the gas inlet and/or outlet system.
- If the problem persists, internal occlusions may exist. Contact your service personnel.

14.7 Removing Exhaust Gases from the System

⚠WARNING

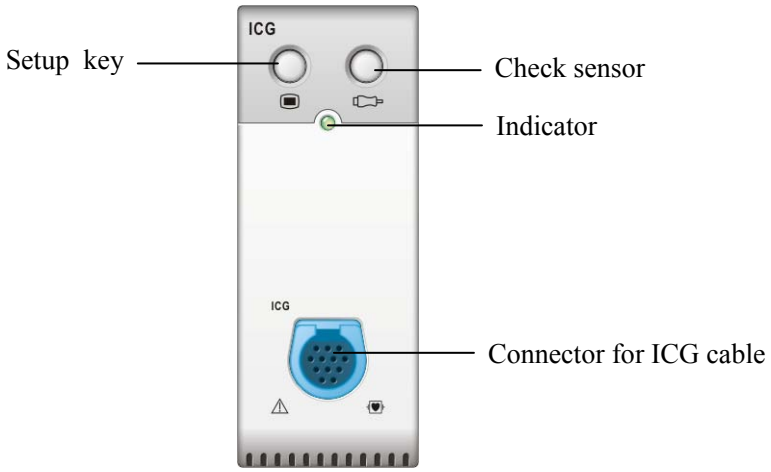
- **Anesthetics: When using the AG measurement on patients who are receiving or have recently received anesthetics, connect the outlet to a scavenging system, or to the anesthesia machine/ventilator, to avoid exposing medical staff to anesthetics.**

To remove the sample gas to a scavenging system, connect an exhaust tube to the gas outlet connector of the module.

15 Monitoring ICG

15.1 Introduction

Impedance cardiography (ICG) measures a patient's hemodynamic status using a safe, non-invasive method based on thoracic electrical bioimpedance (TEB) technology. ICG uses four pairs of sensors to transmit a small electrical signal through the thorax. As velocity and volume of blood in the aorta change, the ICG measures the changes in impedance from systole to diastole to calculate hemodynamic parameters.



15.2 Safety

⚠ WARNING

- **Apply ICG monitoring to adult patients in height of 122 to 229 cm, weight of 30 to 159 kg only.**
- **ICG monitoring should not be used concurrently on patients with minute ventilation pacemakers when the MV sensor function is activated.**
- **During ICG monitoring, make sure that the conductive paste on the ICG sensors never come into contact with other conductive parts.**
- **ICG sensors are for single patient use only.**

15.3 Understanding ICG Parameters

By selecting the ICG parameter window→[**ICG Setup**]→[**Hemodynamic Parameters** >>], you can view the hemodynamic parameters for evaluation of the patient's hemodynamic status.

15.3.1 Measured Parameters

Abbreviation	**Unit**	**Full spelling**
ACI	/100s^2	acceleration index
VI	/1000s	velocity index
TFC	/k Ω	thoracic fluid content
HR*	bpm	heart rate
*The HR value is directly derived from the ICG module.		

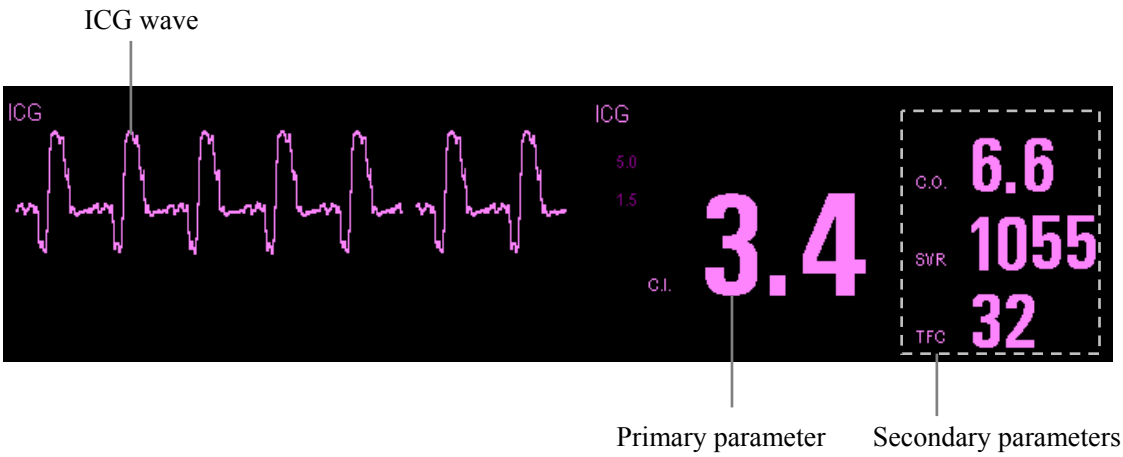
15.3.2 Calculated Parameters

Abbreviation	**Unit**	**Full spelling**
BSA	m^2	Body surface area
C.O.	L/min	Cardiac output
C.I.	L/min/m^2	Cardiac index
SV	ml	Stroke volume
SI	ml/m^2	Stroke index
SVR	DS/cm^5	Systemic vascular resistance
SVRI	DS·m^2/cm^5	Systemic vascular resistance index
PVR	DS/cm^5	Pulmonary vascular resistance
PVRI	DS·m^2/cm^5	Pulmonary vascular resistance index
LCW	kg·m	Left cardiac work
LCWI	kg·m/m^2	Left cardiac work index
LVSW	g·m	Left ventricular stroke work
LVSWI	g·m/m^2	Left ventricular stroke work index
RCW	kg·m	Right cardiac work

Abbreviation	Unit	Full spelling
RCWI	kg·m/m^2	Right cardiac work index
RVSW	g·m	Right ventricular stroke work
RVSWI	g·m/m^2	Right ventricular stroke work index
EF	%	Ejection fraction
TFI	Ω	Thoracic fluid index
STR	none	Systolic time ratio
PEP	ms	Pre-ejection period
LVET	ms	Left ventricular ejection time
VEPT	ml	Volume of electrically participating tissue

15.4 Understanding the ICG Display

The ICG monitoring provides a continuous display of the impedance waveform and 4 numerics. Of 4 numerics, 1 is the primary parameter C.I. and 3 are secondary parameters. The secondary parameters are user-selectable, and C.O., SVR and TFC are the defaults.



By selecting the ICG parameter window, you can access the [**ICG Setup**] menu.

15.5 ICG Limitations

The measurement accuracy may be compromised when patients present with the following conditions or anomalies:

- Septic shock.
- Aortic valve regurgitation.
- Severe hypertension (MAP>130 mmHg).
- The patient's weight and height are out of range.
- Connection to an intra-aortic balloon pump.
- With excessive and continuous patient movements such as shivering.
- Signal interference from cable connections and/or power cords.
- Open-heart surgeries that could result in chest expansion blood flow or current changes.

15.6 Preparing to Monitor ICG

1. Insert the ICG module into the monitor.
2. Connect the patient cable to the ICG module.
3. Prepare the patient's skin and place ICG electrodes on the patient.
4. Connect the ICG sensor connector end to the patient cable.
5. Set up the patient information.

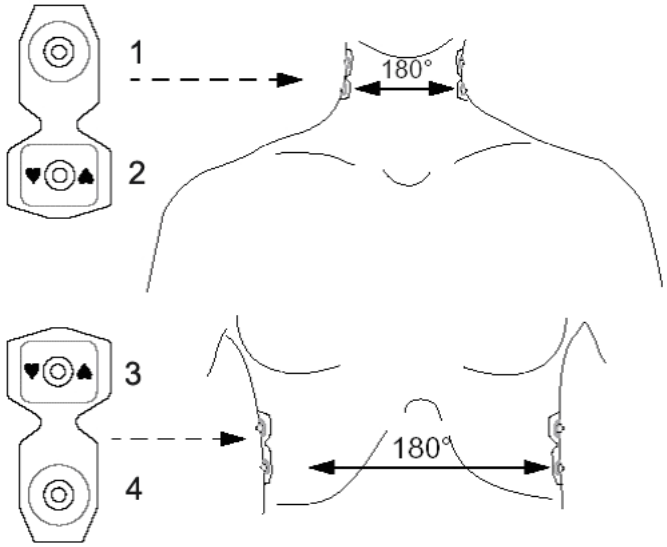
15.6.1 Preparing the Patient

Proper skin preparation is necessary for good signal quality at the sensor, as the skin is a poor conductor of electricity. To properly prepare the skin, choose flat, non-muscular areas and then follow this procedure:

1. Shave hair from skin at chosen sites.
2. Gently rub skin surface at sites to remove dead skin cells.
3. Thoroughly cleanse the site with a mild soap and water solution. Be sure to remove all oily residue, dead skin cells, and abrasives. Leftover abrasion particles can be a source of noise.
4. Dry the skin completely before applying the sensor.

15.6.2 Placing ICG Sensors

Appropriate sensor placement is important for good signal quality and accurate measurements. Attach ICG sensors to the patient as shown below:



1. Two neck sensors placed on each side of the neck, directly below the earlobe.
2. Two thorax sensors placed on each side of the thorax, level with the xyphoid process and in line with the midaxillary line. Each pair of sensors should be opposite directly to each other (180°) as shown in the figure above.

15.6.3 Setting up the Patient Information

1. Select the ICG parameter window to enter the [**ICG Setup**] menu.
2. Select [**Patient Demographics** >>].
3. Select [**Height**] and [**Weight**] and then select the appropriate settings. The patient's height and weight are important for ICG monitoring. The system will automatically check them when an ICG module is connected. If no values are entered or the entered values do not meet the requirements, corresponding prompt messages will be given in the ICG parameter window.
4. Enter other parameters. PAWP, CVP, PA mean and Art mean are obtained from IBP. The Art mean is obtained from either IBP Art or NIBP Mean. If these values cannot be obtained automatically, you can enter them manually.

15.7 Changing ICG Settings

15.7.1 ICG Averaging

The ICG value is the average of multiple measurements. You can select an interval (heart beats) for averaging ICG.

1. Select the ICG parameter window to enter the [**ICG Setup**] menu.
2. Select [**Averaging**] and then select the appropriate setting. The greater the averaging interval is, the less the ICG value is affected by human interference. Vice versa.

15.7.2 Selecting Secondary Parameters

C.O., SVR and TFC are the default three secondary parameters. You can also select your desired secondary parameter for display.

1. Select the ICG parameter window to enter the [**ICG Setup**] menu.
2. Select [**Change Secondary Parameters** >>].
3. Select three parameters from the popup menu.

15.7.3 Checking Sensors

During ICG monitoring, the ICG sensors should be checked regularly to ensure that no sensor becomes disconnected. During sensor checking, the ICG waveform is displayed as a straight line and the message [**ICG Sensor Check**] is displayed. Once a disconnected sensor is detected, a prompt message in which the sensor's application site is indicated will be displayed.

To initiate a sensor check:

- In the [**ICG Setup**] menu, select [**Check Sensor**].
- Press the hardkey.

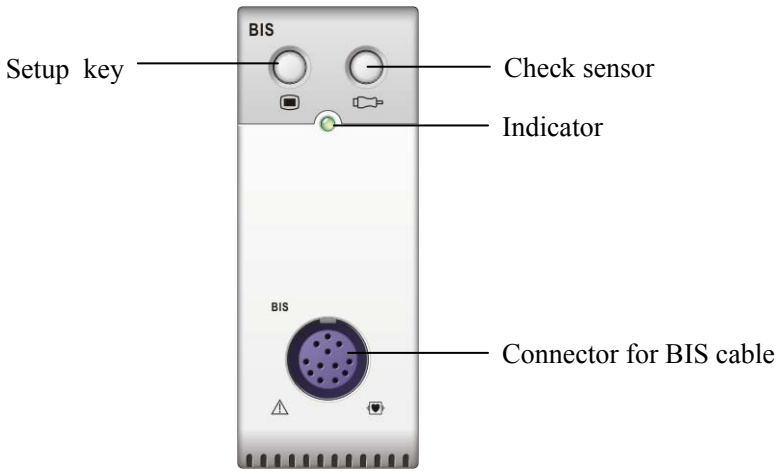
15.7.4 Changing the ICG Wave Speed

1. Select the ICG wave to enter the [**ICG Waveform**] menu.
2. Select [**Sweep**] and then select the appropriate setting. The faster the wave sweeps, the wider the wave is.

16 Monitoring BIS

16.1 Introduction

Bispectral Index (BIS) monitoring helps to monitor the level of consciousness of a patient under general anesthesia or sedation in the OR and ICU. The BIS sensor is placed on the patient's forehead to capture electroencephalographic (EEG) signals from which several numerics are derived, including a single BIS between 100 (wide awake) and zero (absence of brain electrical activity) that represents the patient's level of consciousness. This enables clinicians to customize the precise type and amount of anesthetic or sedative medication that each patient needs.



16.2 Safety Information

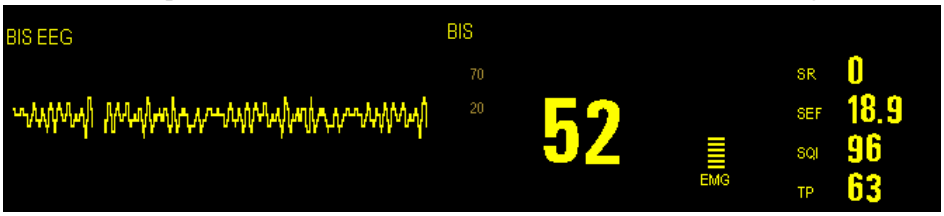
For patients with neurological disorders, patients taking psychoactive medication, and children below the age of 1 year, BIS values should be interpreted cautiously.

⚠WARNING

- **The conductive parts of sensors and connectors should not come into contact with other conductive parts, including earth.**
- **To reduce the hazard of burns in the high-frequency surgical neutral electrode connection, the BIS sensor should not be located between the surgical site and the electro-surgical unit return electrode.**
- **The BIS sensor must not be located between defibrillator pads when a defibrillator is used on a patient connected to the patient monitor.**

16.3 Understanding the BIS Display

The BIS module provides with the monitor an EEG wave and the following numerics:



1. Bispectral Index (BIS)

   The BIS numeric reflects the patient's level of consciousness. It ranges from 100 for wide awake to 0 in the absence of brain activity.

BIS numeric	Description
100	The patient is widely awake.
70	The patient is underdosed but still unlikely to become aware.
60	The patient is under general anesthesia and loses consciousness.
40	The patient is overdosed and in deep hypnosis.
0	The EEG waveform is displayed as a flat line, and the patient has no electrical brain activity.

2. Electromyograph (EMG)

   EMG bar graph reflects the electrical power of muscle activity and high frequency artifacts. The minimum possible EMG is about 25 dB.

   - EMG＜55 dB: this is an acceptable ECG.
   - EMG≤30 dB: this is an optimal EMG.

3. Suppression Ratio (SR)

   SR numeric is the percentage of time over the last 63-second period during which the EEG is considered to be in a suppressed state.

4. Spectral Edge Frequency (SEF)

   The SEF is a frequency below which 95% of the total power is measured.

5. Signal Quality Index (SQI)

   The SQI numeric reflects signal quality and provides information about the reliability of the BIS, SEF, TP, and SR and numerics during the last minute. It ranges from 0-100%:

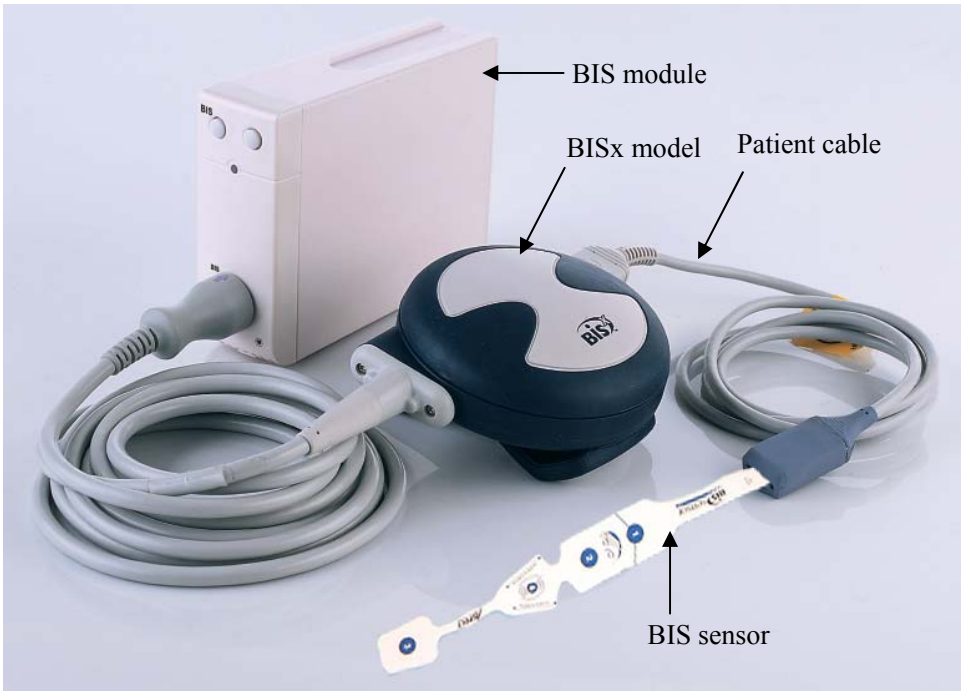
   - 0 to 15%: the numerics cannot be derived.
   - 15% to 50%: the numerics cannot be reliably derived.
   - 50% to 100%: the numerics are reliable.

6. Total Power (TP)

   TP numeric indicates the power in the frequency band 0.5-30Hz. The useful range is 30-100db.

16.4 Setting up the BIS Measurement

1. Connect the BISx model to the BIS module.



2. Use the attachment clip to secure the BISx model near, but not above the level of the patient's head.
3. Connect the BISx model to the patient cable.
4. Attach the BIS sensor to the patient following the instructions supplied with sensor.

NOTE

- **Make sure the patient's skin is dry. A wet sensor or a salt bridge could result in erroneous BIS and impedance values.**

5. Connect the BIS sensor to the patient interface cable. As soon as a valid sensor is detected, the impedances of all electrodes are measured automatically and the impedance value for each electrode is displayed in the sensor check window.

⚠CAUTION

- **Do not attach the BISx model to the patient's skin for long time. Otherwise, the BISx heats while on the patient and may cause discomfort.**

16.5 Continuous Impedance Check

By default, this check is switched on. It checks:

- The combined impedance of the signal electrodes plus the reference electrode. This is done continuously and does not affect the EEG wave. As long as the impedances are within the valid range, no prompt message about this check is given.
- The impedance of the ground electrode. This is done every ten minutes and takes approximately four seconds. It causes an artifact in the EEG wave, and the message [**BIS Ground Checking**] is displayed on the monitor during the check. If the ground electrode does not pass this check, another check is initiated. This continues until the ground electrode passes the check.

If the continuous impedance check interferes with other measurements, it can be switched off. To do this:

1. Select the BIS parameter window to enter the [**BIS Setup]** menu.
2. Select [**Cont. Imped.Check**] and then select [**Off**].

⚠CAUTION

- **Switching off the continuous impedance check off will disable automatic prompt to the user of impedance value changes, which may lead to incorrect BIS values. Therefore, this should only be done if the check interferes with or disturbs other measurements.**

16.6 Cyclic Impedance Check

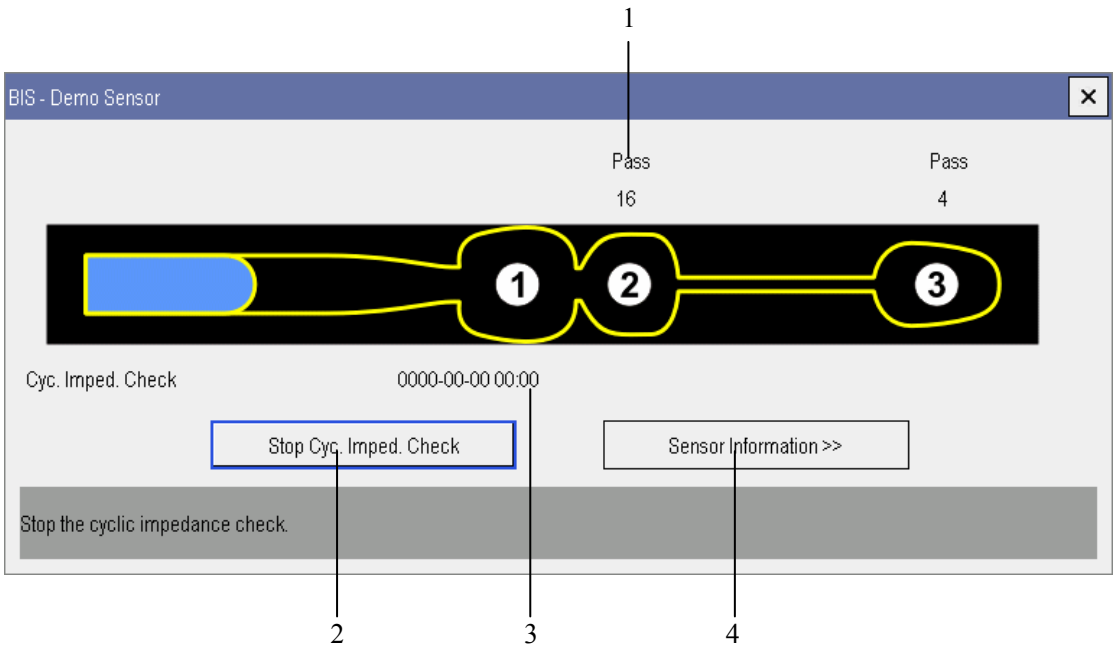
This measures the exact impedance of each individual electrode. It causes a disturbed EEG wave, and a prompt message is displayed on the monitor

- The cyclic impedance check is automatically initiated when a sensor is connected. To manually start a cyclic impedance check manually, you can either:
  - Select [**Cyc Imped. Check**] in the [**BIS Setup**] menu and then select [**On**].
  - Press the hardkey on the BIS module.
  - Select [**Start Cyc Imped. Check**] in the BIS sensor window.

- The cyclic impedance check stops automatically if the impedances of all electrodes are within the valid range. To manually stop a cyclic impedance check, you can either:
  - Select [**Cyc Imped. Check**] in the [**BIS Setup**] menu and then select [**Off**]
  - Press the hardkey on the BIS module.
  - Select [**Stop Cyc Imped. Check**] in the sensor check window.

16.7 BIS Sensor Check Window

To open the sensor check window, select [**Sensor Check** >>] in the [**BIS Setup**] menu. The graphic in the BIS sensor check window automatically adapts to show the type of sensor you are using, show three or four electrodes as required. Each symbol in the graphic represents an electrode and illustrates the most recently-measured impedance status of the electrodes: ① is the reference electrode; ② the ground electrode; ③ and ④ are signal electrodes.



1. Measure electrode impedance 2. Start/stop continuous impedance checks
3. Time of the most recent impedance check 4. Show sensor information

The measured electrode-to-skin impedance and electrode status are displayed above each electrode:

Status	Description	Action
[**Lead Off**]	Electrode falls off and has no skin contact	Reconnect electrode, or check the sensor-to-skin contact. If necessary, clean and dry skin.
[**Noise**]	The EEG signal is too noisy. Impedance cannot be measured	Check the sensor-to-skin contact. If necessary, clean and dry skin.
[**High**]	The impedance is above the limit	
[**Pass**]	The impedance is within valid range	No action necessary.

Although BIS may still be measured when the electrode status is [**Noise**] or [**High**], for best performance, all electrodes should be in [**Pass**] status.

16.8 Choosing the BIS Smoothing Rate

The smoothing rage defines how the monitor averages the BIS value. To choose the smoothing rate:

1. Select the BIS parameter window to enter the [**BIS Setup**] menu.
2. Select [**Smoothing Rate**] and then choose either:
   - [**15 s**]: this gives increased responsiveness to changes in the patient's state.
   - [**30 s**]: this gives a smoother BIS trend with decreased variability and sensitivity to artifacts.

16.9 Setting up the EEG Wave

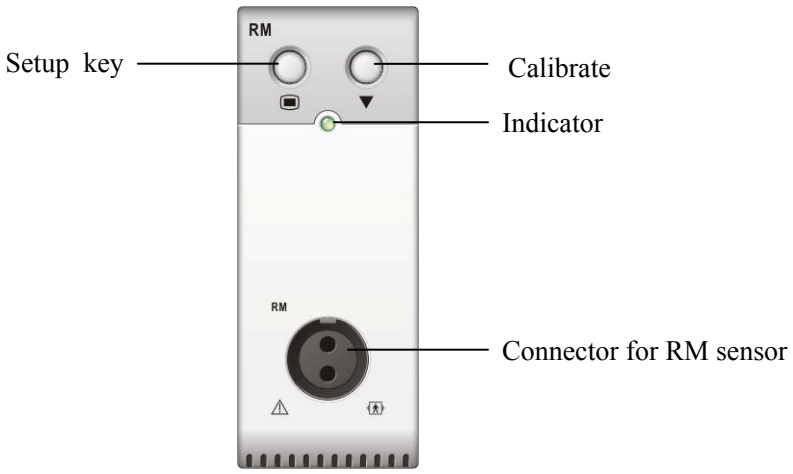
Select the EEG wave to enter the [**BIS EEG Waveform**] menu. In this menu, you can:

- Select [**Scale**] and then select the appropriate setting.
- Select [**Sweep**] and then select the appropriate setting. The faster the wave sweeps, the wider the wave is.

17 Monitoring RM

17.1 Introduction

In the respiratory mechanics measurement, the airway pressures are measured, from the part between the patient circuit and intubation tube, using a flow sensor between the Y-piece of patient circuit and the patient connection. The pressure is transferred to the monitor through the tube and measured by a pressure transducer in the RM module. The pressure difference together with the gas concentration information is used to calculate flow. The volume information is obtained by integrating the flow signal. From these three parameter, other parameter such as RR, I:E, Compl, etc. are derived.



The RM monitoring enables clinicians to understand the ventilator operation and patient respiratory status.

RM monitoring displays the following waveforms and loops:

- Flow waveform
- Paw waveform
- Vol waveform
- FV (flow-volume) loop
- PV (paw-volume) loop

RM monitoring provides values for 18 parameters. The 18 parameters can be classified into 4 categories:

1. Paw parameters

- PIP: peak inspiratory pressure (unit: cmH_2O)
- Pplat: plateau pressure (unit:cmH_2O)
- PEEP: positive end expiratory pressure (unit: cmH_2O)
- Pmean: mean pressure (unit: cmH_2O)

2. Flow parameters
   - PIF: peak inspiratory flow (unit: L/min)
   - PEF: peak expiratory flow (unit: L/min)

3. Vol parameters
   - TVi: inspiratory tidal volume (unit: ml)
   - TVe: expiratory tidal volume (unit: ml)
   - MVi: inspirator minute volume (L)
   - MVe: expiratory minute volume (L)

4. Other parameters
   - RR: respiratory rate (unit: rpm)
   - I: E: ratio of the inspiratory and expiratory time
   - Compl: compliance (unit: ml/cmH_2O)
   - Raw: airway resistance (unit: cmH_2O/L/s)
   - FEV1.0%: first second forced expiratory volume ratio (unit: %)
   - RSBI: rapid shallow breathing index (unit: rpm/L)
   - NIP: negative inspiratory pressure (cmH_2O)
   - WOB: work of breathing (J/L)

17.2 Safety Information

⚠WARNING

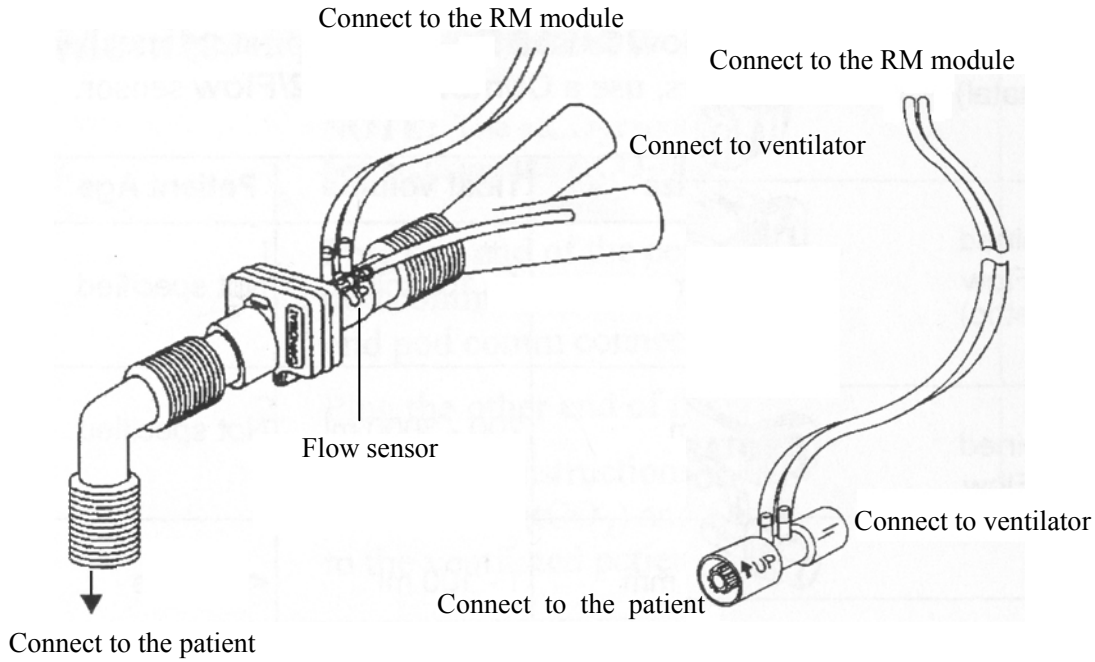
- **Check for leaks in the breathing circuit system, as they may significantly affect respiratory mechanics readings.**
- **Verify the Ventilation Mode. Improper settings of this function will cause incorrect calculations of some parameters.**
- **Match the airway adapter you select to the appropriate patient category. Improper sensor selection may produce excessive ventilation resistance or introduce excessive airway deadspace, as well as inaccurate scales and alarm limits.**
- **Periodically check the flow sensor and tubing for excessive moisture or secretion build-up and purge if necessary.**

NOTE

- **To avoid the affects of excessive moisture in the measurement circuit, insert the flow sensor airway adapter in the breathing circuit with the tubes upright.**
- **Do not place the airway adapter between the endotracheal tube and an elbow as this may allow patient secretions to block the adapter windows.**

17.3 Preparing to Monitor RM

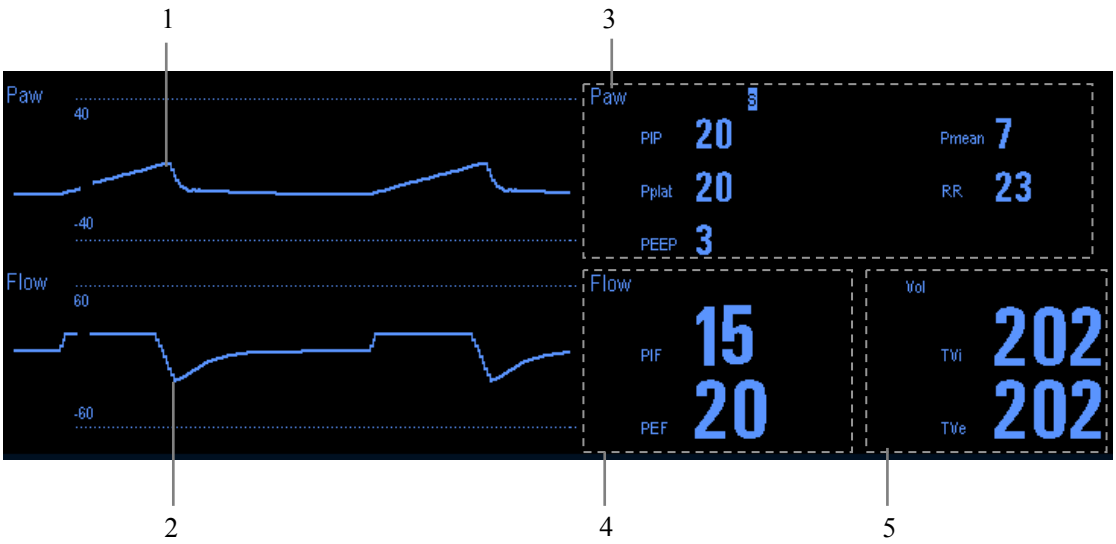
1. Select an appropriate flow sensor in accordance with the patient category.
2. Connect the small tubes of the flow sensor to the RM connector of the module using a color-coded adapter.
3. Insert the flow sensor between the Y-piece of the patient circuit and the patient connection.



4. Select the RM parameter window to open the [**RM Setup**] menu.
5. Select [**Sensor Type**] and then choose either [**Disposable**] or [**Reusable**] according to the selected sensor.
6. Select [**Ventilation Mode**] and then choose either [**Spontaneous**] or [**Mechanical**] according to the patient's ventilation status.

17.4 Understanding the RM Display

The RM display shows either the Paw and Flow waveforms, or the Paw and Vol waveforms in the waveform area.



1. Paw waveform
2. Flow waveform
3. Paw parameter window
4. Flow parameter window
5. Vol parameter window

In the Paw parameter window, “S” stands for spontaneous respiration and “M” for mechanical ventilation.

17.5 Changing RM Settings

17.5.1 Accessing RM Menus

- By selecting the RM parameter window, you can access the [**RM Setup**] menu.
- By selecting the Paw wave, you can access the [**Paw Waveform**] menu.
- By selecting the Flow wave, you can access the [**Flow Waveform**] menu.
- By selecting the Vol wave, you can access the [**Vol Waveform**] menu.

17.5.2 Setting the Apnea Alarm Delay

In the [**RM Setup**] menu, select [**Apnea Time**] and then select the appropriate setting. The monitor will alarm if the patient has stopped breathing for longer than the preset apnea time.

17.5.3 Selecting TV or MV for Display

To select tidal volume (TV) or minute volume (MV) for display in the Vol parameter window, in the [**RM Setup**] menu, select [**TV/MV**] and toggle between [**TV**] and [**MV**]. By default, the Vol parameter window displays TV values.

17.5.4 Selecting Flow or Vol Waveform for Display

To select Flow or Vol waveform for display:

1. Select the currently displayed Flow or Vol waveform to enter its waveform menu.
2. Select [**Flow/Vol**] and toggle between [**Flow**] and [**Vol**].

17.5.5 Changing the Wave Sweep Speed

1. Select your desired waveform to enter its waveform menu.

2. Select [**Sweep**] and select the appropriate setting. The faster the wave sweeps, the wider the wave is.

17.5.6 Changing the Wave Scale

The wave scale changes automatically if [**Scaling**] is set to [**Auto**].

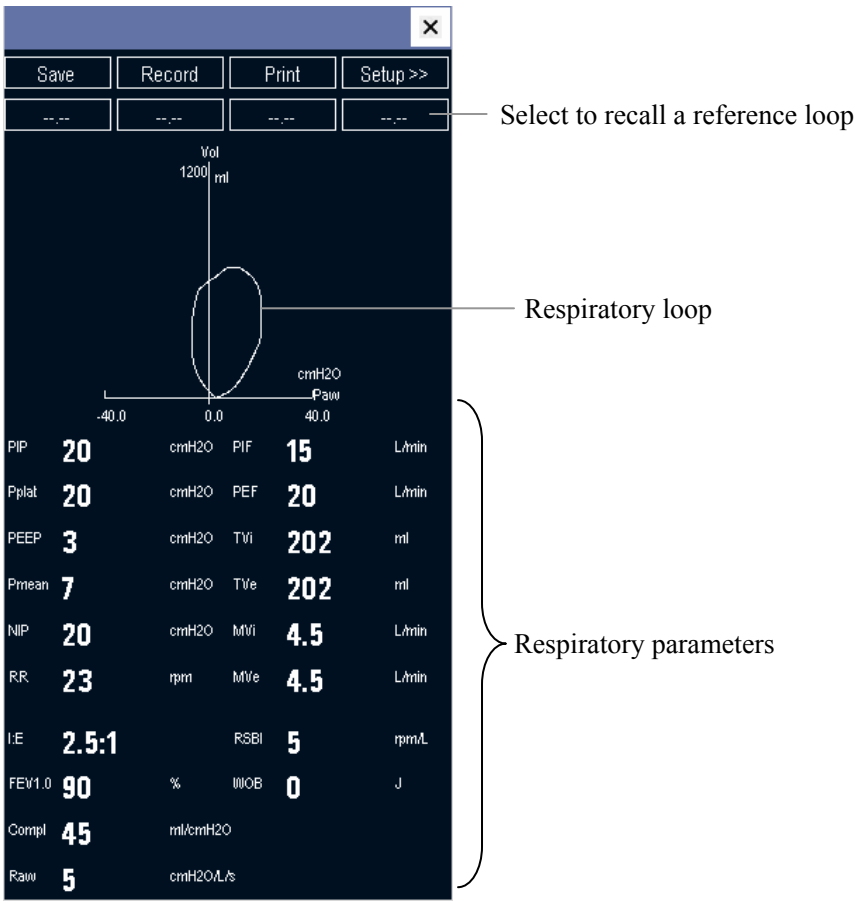
1. Select your desired waveform to enter its waveform menu.
2. Select [**Scaling**] and then select [**Auto**].

To manually adjust the wave scale (take the Paw wave for example):

1. Select the Paw waveform to enter the [**Paw Waveform**] menu.
2. Select [**Scaling**] and then select [**Manual**].
3. Select [**Paw Scale**] and then select the appropriate setting.

17.6 Understanding the Respiratory Loops

Select [**Respiratory Loop**] in the [**RM Setup**] menu. The following window will be displayed.



In this window, you can:

- Select [**Save**] to save the respiratory loops in the current respiratory cycle as the reference loops. Up to 4 groups of respiratory loops can be saved, and the saving time is displayed above the respiratory loops.
- Change the respiratory loops displayed on the screen: select [**Setup >>**]→[**Display Loop**] and then toggle between [**PV Loop**] and [**FV Loop**].
- Recall a reference loop: select [**Setup >>**]→[**Reference Loop**]→[**On**] and then select a saved reference loop.
- Change the size of the PV and FV loops: select [**Setup >>**]→[**Scaling**]→[**Manual**] and then adjust the [**Paw Scale**], [**Vol Scale**] or [**Flow Scale**]. You can also set [**Scaling**] to [**Auto**]. The scaling of the parameters is automatically adjusted to suit the patient's respiratory condition.
- Print out all parameters for a reference loop by selecting your desired reference loop and then selecting [**Record**].

17.7 Zeroing the RM Module

A zero calibration is carried out automatically every time when the module is switched on or connected, and then 10 minutes after that. Then, a zero calibration is triggered every 30 minutes. You can also start a manual zero calibration when there is a drift in the zero: in the [**RM Setup**] menu, select [**Zero RM**].

17.8 Calibrating the Flow Sensor

A calibration must be performed every time when the flow sensor is changed.

1. In the [**RM Setup**] menu, select [**Calibrate RM >>**].
2. Enter the positive factor provided on the flow sensor and select [**Calibrate**].
3. Enter the negative factor provided on the flow sensor and select [**Calibrate**].
4. After the calibration is completed successfully, the last calibration time and the message [**Calibration Completed!**] are displayed. Otherwise, the message [**Calibration Failed!**] is displayed.

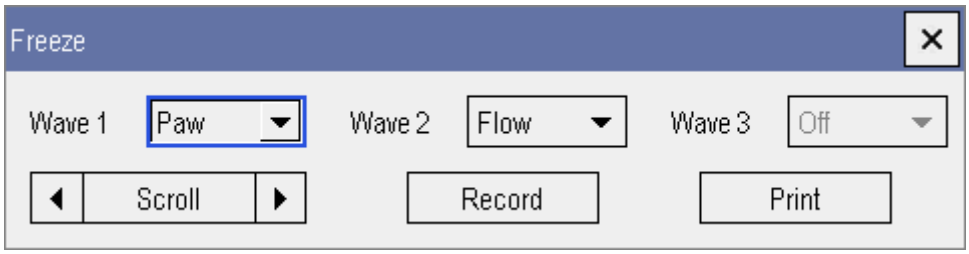
FOR YOUR NOTES

18 Freezing Waveforms

During patient monitoring, the freeze feature allows you to freeze the currently displayed waveforms on the screen so that you can have a close examination of the patient's status. Besides, you can select any three frozen waveforms for recording.

18.1 Freezing Waveforms

1. To freeze waveforms, select the ⋈ hardkey on the monitor's front, or the ⋈ on-screen QuickKey.
2. The system closes the displayed menu (if any), and open the [**Freeze**] menu.



3. All displayed waveforms are frozen, i.e. the waveforms stop being refreshed or scrolling.

The freeze feature exerts no effect on the split-screen view of minitrends, oxyCRG and other patients.

18.2 Viewing Frozen Waveforms

To view the frozen waveforms, you can either:

- Select the [**Scroll**] button and then rotate the Knob clockwise or counter-clockwise, or
- Directly select the ◀ or ▶ beside the [**Scroll**] button using a mice or through the touchscreen.

At the lower right corner of the bottommost waveform, there is an upward arrow. The frozen time is displayed below the arrow. With each step or click, the frozen time changes at intervals of 1 second.

18.3 Unfreezing Waveforms

To unfreeze the frozen waveforms, you can either:

- Select the ✕ button at the upper right corner of the [**Freeze**] menu, or
- Select the ⋈ hardkey on the monitor's front or the ⋈ on-screen QuickKey again, or
- Perform any other action that can cause the screen to be readjusted or open a menu, such as plugging in or out a module, pressing the ▭ hardkey, etc.

18.4 Recording Frozen Waveforms

1. In the [**Freeze**] menu, select, in turn, [**Wave 1**], [**Wave 2**] and [**Wave 3**] and then select your desired waveforms.
2. Select the [**Record**] button. The selected waveforms and all numerics at the frozen time are printed out by the recorder.

19 Review

19.1 Accessing Respective Review Windows

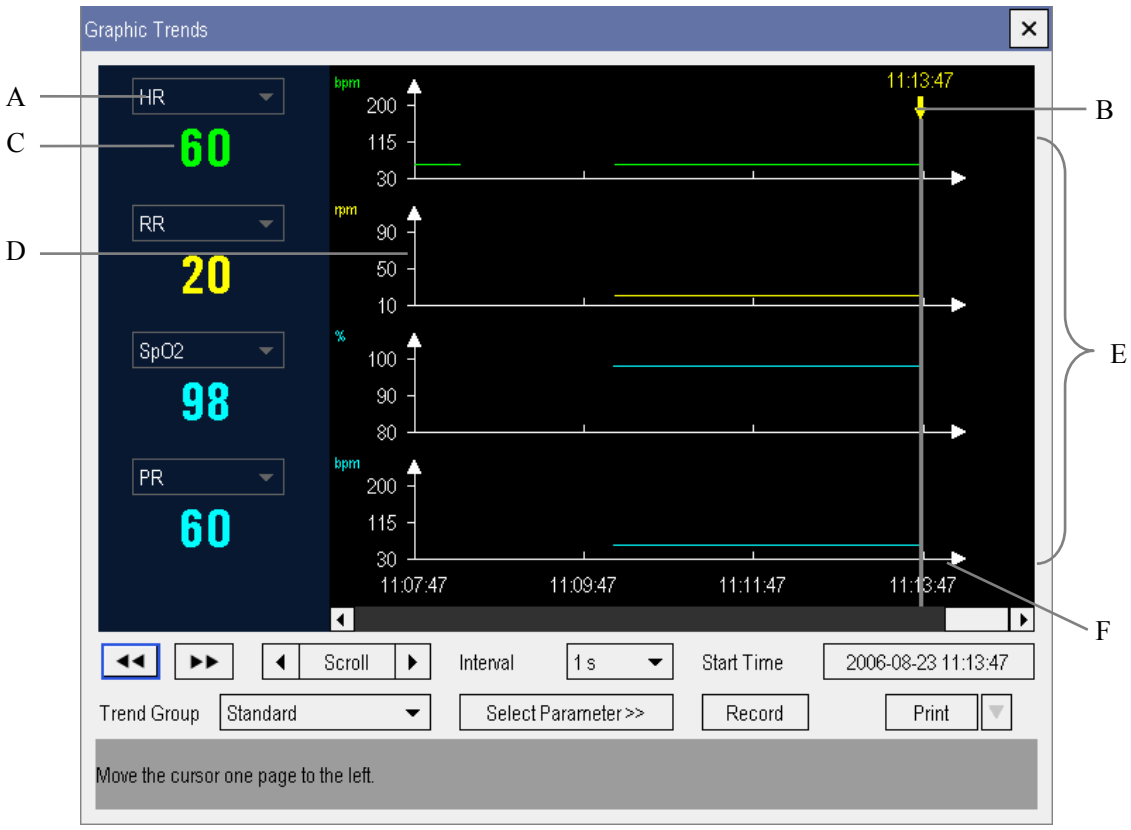
1. Select the [**Review**] QuickKey, or [**Main Menu**]→[**Review >>**].

2. Select [**Graphic Trends**], [**Tabular Trends**], [**NIBP**], [**Arrh. Events**], [**Alarms**], [**Full Disclosure**] or [**12-Lead Analysis**] to access their respective review windows.

For details about reviewing arrhythmia events and 12-lead analysis results, refer to the chapter ***7 Monitoring ECG/Resp***.

19.2 Reviewing Graphic Trends

In the [**Review**] menu, select [**Graphic Trends**] to access the following window.



A. Parameter combo box B. Slider C. Parameter value

D. Parameter scale E. Graphic trends F. Time axis

In this review window:

- To select parameters for viewing, you can either:
  - Select respective parameter combo boxes and then select your desired parameters, or
  - Select [**Trend Group**] and then select a group from the popup list, or
  - Select [**Select Parameter**>>] and then select your desired parameters from the popup menu.

- You can set the start time of the trends you want to view by selecting [**Start Time**].

- You can change the resolution of the trend data by selecting [**Interval**] and then selecting the appropriate setting:
  - [**1 s**]: select to view up to 1 hour of graphic trends at 1-second resolution.
  - [**5 s**]: select to view up to 8 hours of graphic trends at 5-second resolution.
  - [**1 min**], [**5 min**] or [**10 min**]: select to view up to 120 hours of graphic trends at 1-, 5, or 10-minute resolution.

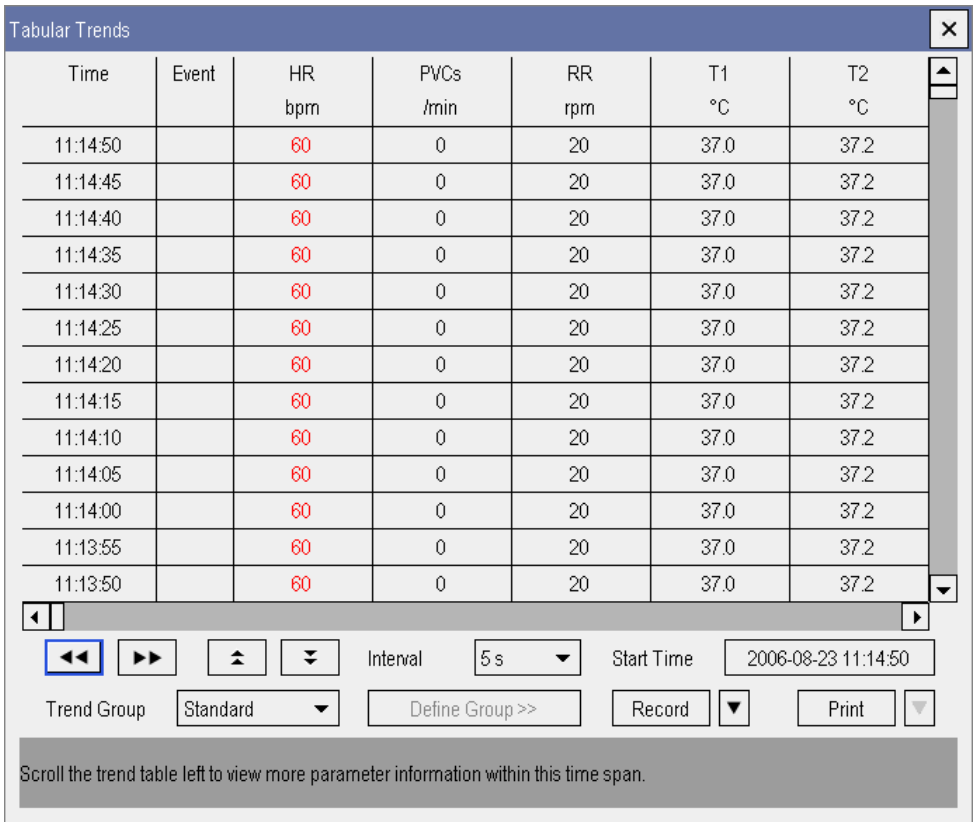
- To browse the graphic trends, you can either:
  - select ◀ or ▶ to move the cursor one step to the left or right to navigate through the graphic trends, or
  - Select ◀◀ or ▶▶ to move the cursor one page to the left or right to navigate through the graphic trends.

  A time indicating your current position is displayed above the cursor. Numeric measurement values corresponding to the cursor location appear in the left side of the [**Graphic Trends**] window, and change as the cursor is moved.

- By selecting the [**Record**] button, you can print out the currently displayed graphic trends by the recorder.

19.3 Reviewing Tabular Trends

In the [**Review**] menu, select [**Tabular Trends**] to access the following window.



In this review window:

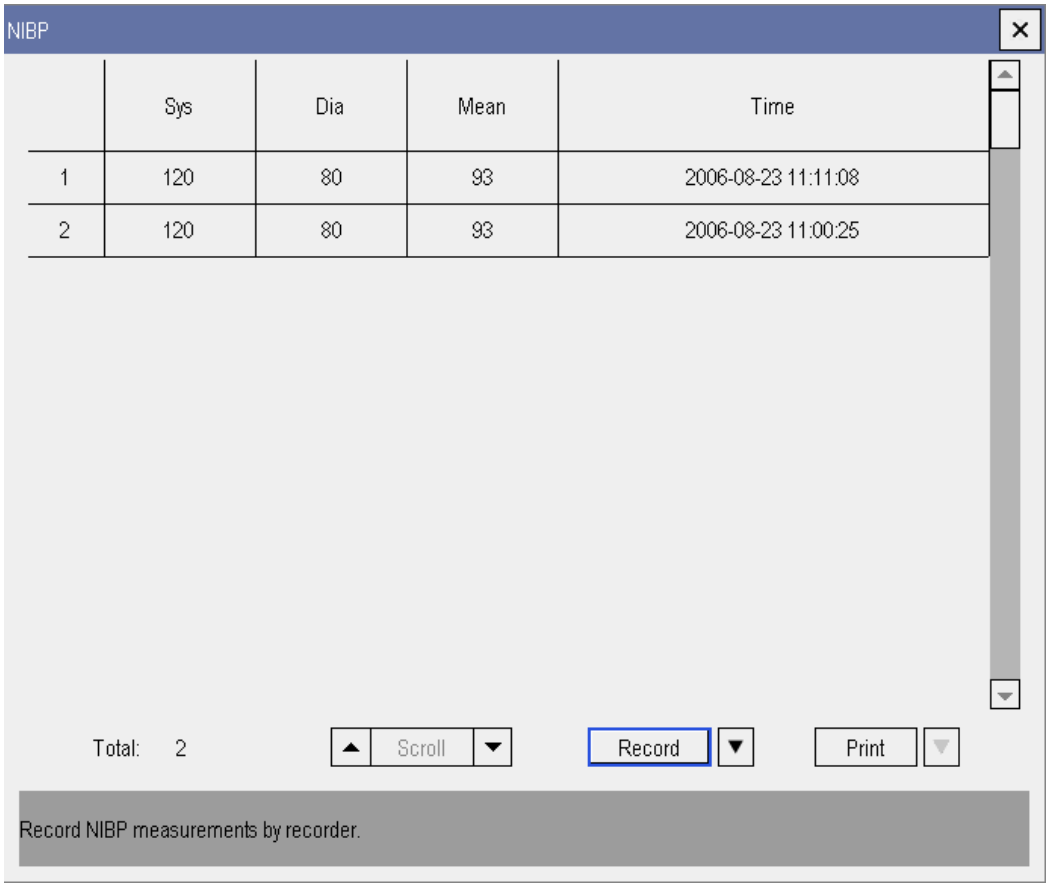
- To select parameters for viewing, you can either:
  - Select [**Trend Group**] and then select a group from the popup list, or
  - Select the [**Define Group**>>] button and then select the parameters you want to view from the popup menu.
- You can set the start time of the trends you want to view by selecting [**Start Time**].
- You can change the resolution of the trend data by selecting [**Interval**] and then selecting the appropriate setting:
  - [**5 s**] or [**30 s**]: select to view up to 8 hours of tabular trends at 5- or 30-second resolution.
  - [**1 min**], [**5 min**], [**10 min**], [**30 min**] or [**1 h**]: select to view up to 120 hours of tabular trends at your selected resolution.
- To browse the tabular trends, you can either:

- Select ◀ or ▶ beside the horizontal scrollbar to drag the scrollbar left or right to navigate through the trend database, or
- Select ◀◀ or ▶▶ to scroll left or right to navigate through the trend database.
- Select ▲ or ▼ beside the vertical scrollbar to drag the scrollbar up or down to view more measurement values, or
- Select ⏫ or ⏬ to scroll up or down to view more measurement values.

- By selecting the [**Record**] button , you can print out the currently displayed tabular trends by the recorder.
- By selecting ▼ beside the [**Record**] button, you can access the [**Record Setup**] menu and set the start and end time of the tabular trends you want to record. This feature is not available when reviewing a historic patient.

19.4 Reviewing NIBP Measurements

In the [**Review**] menu, select [**NIBP**] to access the following window. This window displays systolic pressure, diastolic pressure, mean pressure and time for each measurement. Besides, the total number of measurements is displayed at the lower left corner.

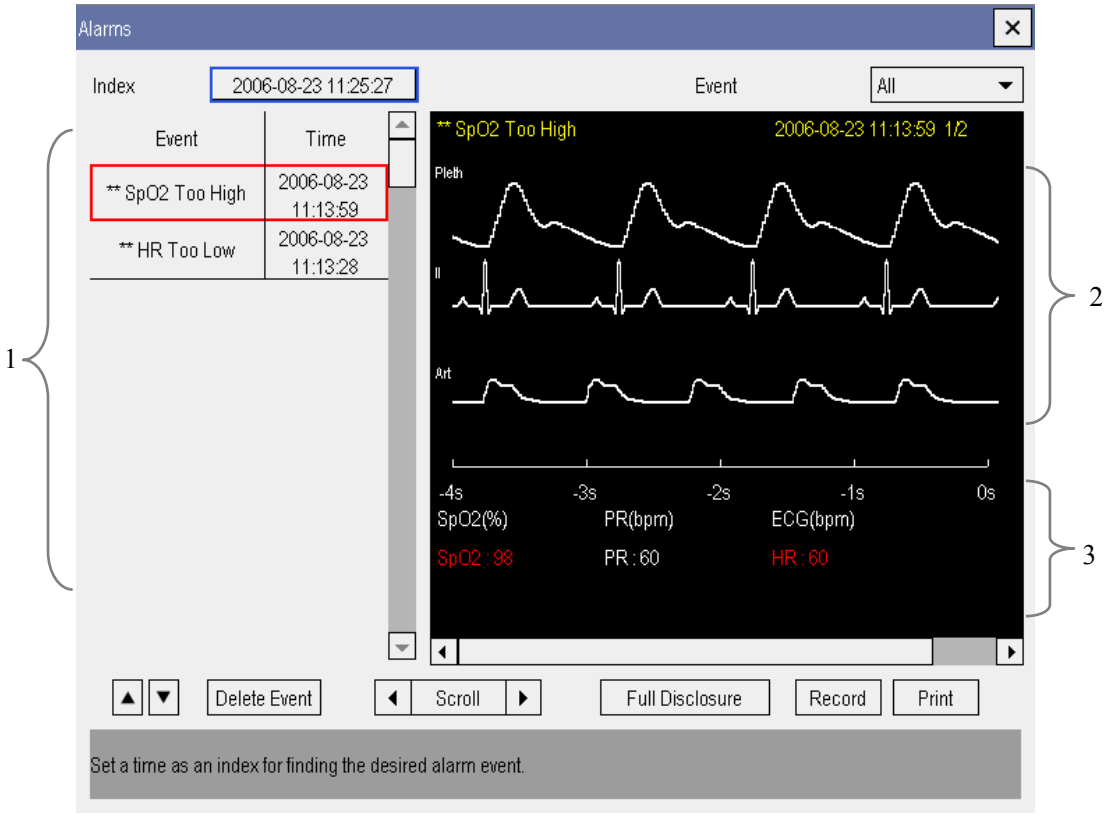


In this review window:

- Up to 10 measurements can be displayed at a time. You can select ▲ or ▼ beside the [**Scroll**] button to view more measurements.
- By selecting the [**Record**] button, you can print out the currently displayed NIBP measurements by the recorder.
- By selecting ▼ beside the [**Record**] button, you can access the [**Record Setup**] menu and set the start and end time of NIBP measurements you want to record. This feature is not available when reviewing a historic patient.

19.5 Reviewing Alarms

When a measurement alarm occurs, all relative measurement numerics at the alarm trigger time and related waveforms 2, 4 or 8 seconds respectively before and after the alarm trigger time are stored. To review the stored alarms, select [**Review**]→[**Alarms**] to access the following window.



1. Event list 2. Waveform area 3. Parameter area

In this review window:

- You can set a time as the index for finding your desired alarm event. There are up to 100 alarm events stored in the database. If you set a time that is too early, the earliest alarm event will be recalled. If you set a time that is too late, the last alarm event will be recalled.
- You can view the desired measurement alarms by selecting [**Event**] and then selecting the measurement whose alarms you want to view. [**All**] includes all measurements.
- To select an alarm event for viewing, you can either:
  - Select the ▲ or ▼ button, or
  - Directly select your desired alarm event on the screen.
- As soon as an alarm event is selected, its measurement numerics and related waveforms are displayed respectively in the parameter and waveform area.
- You can select ◀ or ▶ to navigate through the waveforms.

- By selecting the [**Record**] button, you can print out the currently displayed alarm events by the recorder.
- You can select [**Full Disclosure**] to access the waveform review window. However, if you do not save waveforms beforehand, the message [**Searching Data Failed!**] will be displayed.

19.6 Reviewing Waveforms

In the [**Review**] menu, select [**Full Disclosure**] to access the following window.

A. Parameter combo box B. Slider C. Parameter value

D. Full-disclosure waveform E. Time axis

In this review window:

- To review full-disclosure waveforms, you need to save waveforms first. Select [**Save Waves >>**] and then select the parameters whose waveforms you want to view. To save full-disclosure waveform, your monitor must be equipped with a CF storage card.
- You can set the start time of the waveforms you want to view by selecting [**Start Time**] and then selecting the appropriate settings.
- You can select a waveform you want to view from either parameter combo box.
- To view the waveforms, you can either:

- Select ◀ or ▶ beside the [**Scroll**] button to move the cursor one step left or right to navigate through the waveforms, or
- Select ◀◀ or ▶▶ to move the cursor one page left or right to navigate through the waveforms.

A time indicating your current position is displayed above the cursor. Numeric measurement values corresponding to the cursor location are displayed in the left side of the [**Waveforms**] window, and change as the cursor is moved.

- You can change the wave gain by selecting [**Gain**] and then selecting the appropriate setting. The number of waveforms displayed in this window is subject to the wave gain.
- You can change the waveform sweep speed by selecting [**Sweep**] and then selecting the appropriate setting.
- By selecting the [**Record**] button, you can print out the first three waveforms and measurement numerics.

FOR YOUR NOTES

20 Calculations

20.1 Introduction

The calculation feature is available with your patient monitor. The calculated values, which are not directly measured, are computed based on the values you provide.

Your can perform the following calculations:

- Dose calculations
- Oxygenation calculations
- Ventilation calculations
- Hemodynamic calculations
- Renal calculations

To perform a calculation, select [**Main Menu**] → [**Calculations >>**], or the [**Calculations**] QuickKey and then select the calculation you want to perform.

NOTE

- **The calculation feature is independent of other monitoring functions and can be therefore used for patients being monitored by other monitors. Any operation in a calculation window does not affect the patient monitoring by the local patient monitor.**

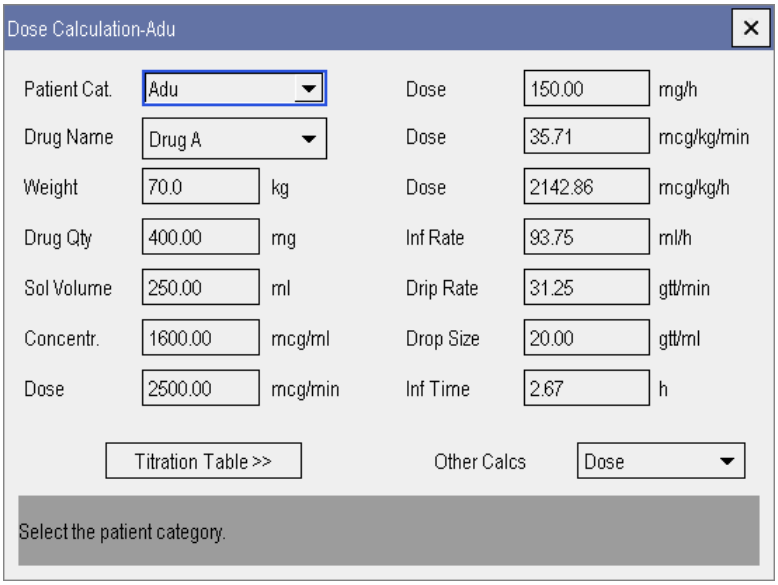
⚠ WARNING

- **After the calculation is finished, verify the entered values are correct and the calculated values are appropriate. We assume no responsibility for any consequences caused by wrong entries and improper operations.**

20.2 Dose Calculations

20.2.1 Performing Calculations

1. By selecting [**Main Menu**]→[**Calculations** >>]→[**Dose** >>], or selecting [**Calculations**] QuickKey→[**Dose** >>], you can access the following window.



2. Select, in turn, [**Patient Cat.**] and [**Drug Name**] and then select the appropriate settings. The dose calculation program has a library of commonly used drugs, of which Drug A through Drug E are for those not specified in this library.

   - Drug A, B, C, D, E
   - Aminophylline
   - Dobutamine
   - Dopamine
   - Epinephrine
   - Heparin
   - Isuprel
   - Lidocaine
   - Nipride
   - NItroglycerin
   - Pitocin

3. The system gives a set of default values when the above steps are finished. However, these values cannot be used as the calculated values. The user must enter values following the doctor's instructions, and then the calculated values can only be used
4. Enter the patient's weight.
5. Enter other values.
6. Verify if the calculated values are correct.

20.2.2 Selecting the Proper Drug Unit

Each drug has its fixed unit or unit series. Among a unit series, one unit may change to another automatically depending on the entered value.

The units for each drug are as follows:

- Drug A, B, C, Aminophylline, Dobutamine, Dopamine, Epinephrine, Isuprel, Lidocaine, Nipride and NItroglycerin use the unit series: g, mg and mcg.
- Drug D, Heparin and Pitocin uses the unit series: Unit, KU (kilo units) and MU (million units).
- Drug E uses the unit: mEq (milli-equivalents).

You must select the proper drug name (A, B, C, D or E) according to the units when you define a drug not listed in this library.

NOTE

- **For neonate patients, [Drip Rate] and [Drop Size] are disabled.**

20.2.3 Titration Table

After the dose calculation is finished, select [**Titration Table >>**] in the [**Dose Calculation**] window. A titration table will be displayed as follows.

In the titration table, when you change:

- [**Reference**]
- [**Interval**]
- [**Dose Type**]

The titrated values change accordingly.

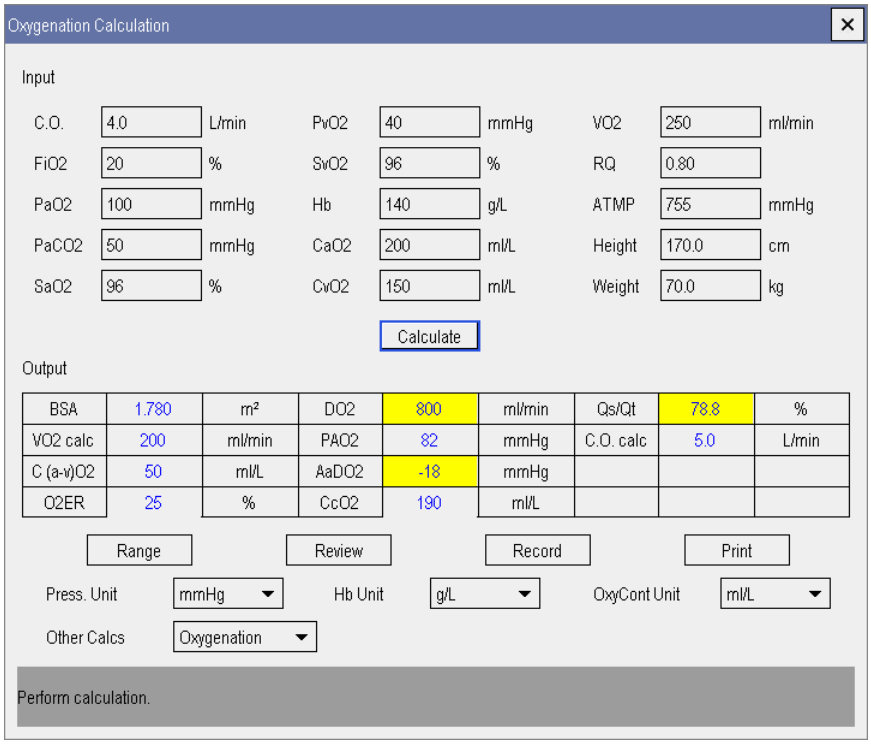
You can also:

- Select ⏫ or ⏬, or ▲ or ▼ beside the vertical scrollbar to view more values.
- Select [**Record**] to print out the currently displayed titrated values by the recorder.

20.3 Oxygenation Calculations

20.3.1 Performing Calculations

1. By selecting [**Main Menu**]→[**Calculations** >>]→[**Oxygenation** >>], or selecting [**Calculations**] QuickKey→[**Oxygenation** >>], you can access the following window.



2. Enter values for calculation.
3. Select the [**Calculate**] button. The system performs a calculation per the current settings and displays the calculated values.
   - ◆ If a calculated value is outside the range, its background will highlight in yellow. You can select [**Range**] to view its normal range in the unit field. For those who are within the range, their unit fields appear blank.
   - ◆ Invalid values are displayed as [---].

In the [**Oxygenation Calculation**] window, you can:

- ■ Change the pressure unit, Hb unit and oxygen content unit by selecting [**Press. Unit**], [**Hb Unit**] and [**OxyCont Unit**] and then selecting the appropriate settings. The changes take effect automatically.
- ■ Trigger a recording by selecting the [**Record**] button. The currently displayed oxygenation calculations are printed out by the recorder.
- ■ Review the previously performed calculations by selecting [**Review**].

- Switch to other calculation window by selecting [**Other Calcs**] and then selecting the calculation you want.

20.3.2 Entered Parameters

Abbreviation	Unit	Full spelling
C.O.	L/min	cardiac output
FiO2	%	percentage fraction of inspired oxygen
PaO2	mmHg	arterial oxygen level
PaCO2	mmHg	arterial carbon dioxide level
SaO2	%	arterial oxygen saturation
PvO2	mmHg	venous oxygen level
SvO2	%	venous oxygen saturation
Hb	g/L	hemoglobin
CaO2	ml/L	arterial oxygen content
CvO2	ml/L	venous oxygen content
VO2	ml/min	oxygen consumption
RQ	None	respiratory quotient
ATMP	mmHg	atmospheric pressure
Height	cm	height
Weight	kg	weight

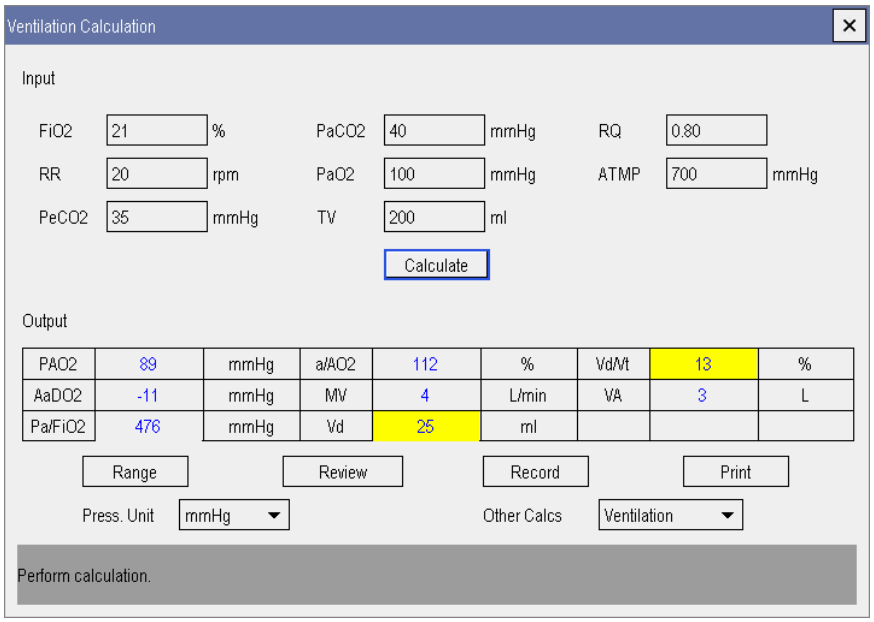
20.3.3 Calculated Parameters

Abbreviation	Unit	Full spelling
BSA	m^2	body surface area
VO2 calc	ml/min	oxygen consumption
C(a-v)O2	ml/L	arteriovenous oxygen content difference
O2ER	%	oxygen extraction ratio
DO2	ml/min	oxygen transport
PAO2	mmHg	alveolar oxygen level
AaDO2	mmHg	alveolar-arterial oxygen difference
CcO2	ml/L	capillary oxygen content
Qs/Qt	%	venous admixture
C.O. calc	L/min	calculated cardiac output

20.4 Ventilation Calculations

20.4.1 Performing Calculations

1. By selecting [**Main Menu**]→[**Calculations** >>]→[**Ventilation** >>], or selecting [**Calculations**] QuickKey→[**Ventilation** >>], you can access the following window.



2. Enter values for calculation.
3. Select the [**Calculate**] button. The system performs a calculation per the current settings and displays the calculated values.
   - ◆ If a calculated value is outside the range, its background will highlight in yellow. You can select [**Range**] to view its normal range in the unit field. For those who are within the range, their unit fields appear blank.
   - ◆ Invalid values are displayed as [---].

In the [**Ventilation Calculation**] window, you can:

- ■ Change the pressure unit by selecting [**Press. Unit**] and then selecting the appropriate setting. Corresponding pressure values shall convert and update automatically.
- ■ Trigger a recording by selecting the [**Record**] button. The currently displayed ventilation calculations are printed out by the recorder.
- ■ Review the previously performed calculations by selecting [**Review**].
- ■ Switch to other calculation window by selecting [**Other Calcs**] and then selecting the calculation you want.

20.4.2 Entered Parameters

Abbreviation	Unit	Full spelling
FiO2	%	percentage fraction of inspired oxygen
RR	rpm	respiration rate
PeCO2	mmHg	mixed expire CO2 pressure
PaCO2	mmHg	arterial carbon dioxide level
PaO2	mmHg	arterial oxygen level
TV	ml	tidal volume
RQ	None	respiratory quotient
ATMP	mmHg	atmospheric pressure

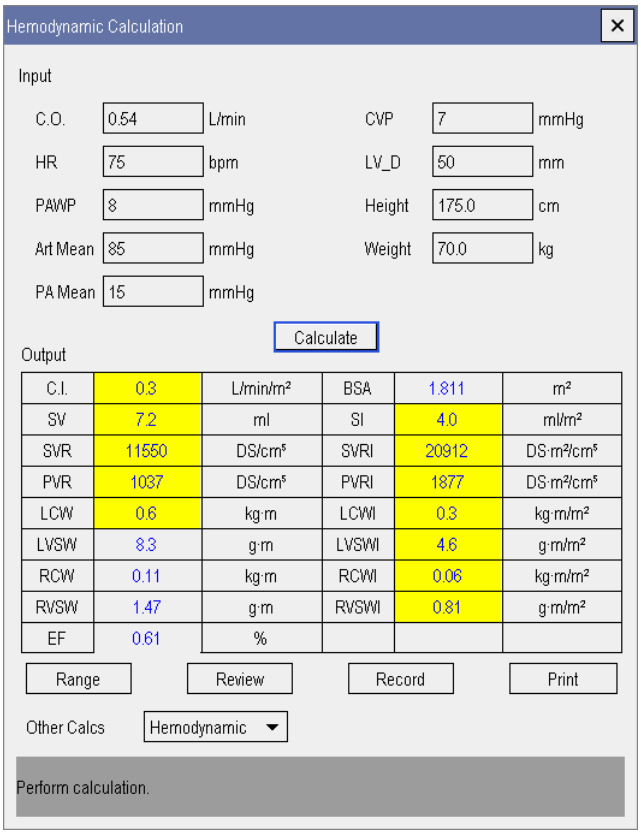
20.4.3 Calculated Parameters

Abbreviation	Unit	Full spelling
PAO2	mmHg	alveolar oxygen level
AaDO2	mmHg	alveolar-arterial oxygen difference
Pa/FiO2	mmHg	oxygenation ratio
a/AO2	%	arterial to alveolar oxygen ratio
MV	L/min	minute ventilation
Vd	ml	volume of physiological dead space
Vd/Vt	%	physiologic dead space in percent of tidal volume
VA	L	alveolar volume

20.5 Hemodynamic Calculations

20.5.1 Performing Calculations

1. By selecting [**Main Menu**]→[**Calculations** >>]→[**Hemodynamic** >>], or selecting [**Calculations**] QuickKey→[**Hemodynamic** >>], you can access the following window.



2. Enter values for calculation.
   - For a patient who is being monitored, [**HR**], [**Art mean**], [**PA mean**] and [**CVP**] are automatically taken from the currently measured values. If you just have performed C.O. measurements, [**C.O.**] is the average of multiple thermodilution measurements. [**Height**] and [**Weight**] are the patient's height and weight you have entered. If the monitor does not provide these values, their fields appear blank.
   - For a patient who is not being monitored, confirm the values you have entered.
3. Select the [**Calculate**] button. The system performs a calculation per the current settings and displays the calculated values.

- If a calculated value is outside the range, its background will highlight in yellow. You can select [**Range**] to view its normal range in the unit field. For those who are within the range, their unit fields appear blank.
- Invalid values are displayed as [---].

In the [**Hemodynamic Calculation**] window, you can:

- Trigger a recording by selecting the [**Record**] button. The currently displayed renal calculations are printed out by the recorder.
- Review the previously performed calculations by selecting [**Review**].
- Switch to other calculation window by selecting [**Other Calcs**] and then select the calculation you want.

20.5.2 Entered Parameters

Abbreviation	**Unit**	**Full spelling**
C.O.	L/min	cardiac output
HR	bpm	heart rate
PAWP	mmHg	pulmonary artery wedge pressure
Art Mean	mmHg	artery mean pressure
PA Mean	mmHg	pulmonary artery mean pressure
CVP	mmHg	central venous pressure
LV_D	mm	left ventricular diameter
Height	cm	height
Weight	kg	weight

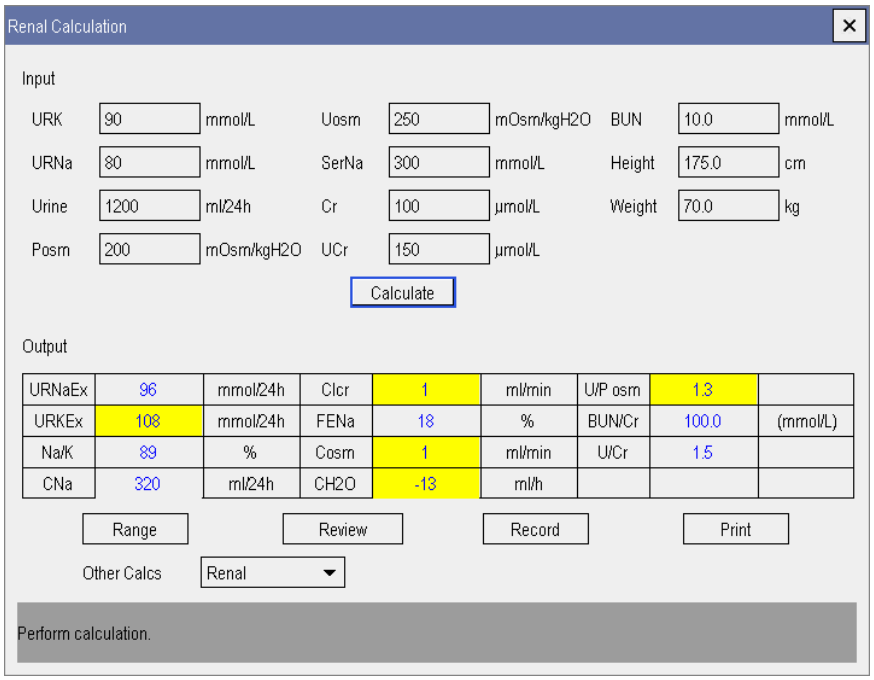
20.5.3 Calculated Parameters

Abbreviation	Unit	Full spelling
C.I.	$L/min/m^2$	cardiac index
BSA	m^2	body surface area
SV	ml	stroke volume
SI	ml/m^2	stroke index
SVR	DS/cm^5	systemic vascular resistance
SVRI	$DS \cdot m^2/cm^5$	systemic vascular resistance index
PVR	DS/cm^5	pulmonary vascular resistance
PVRI	$DS \cdot m^2/cm^5$	pulmonary vascular resistance index
LCW	kg·m	left cardiac work
LCWI	$kg \cdot m/m^2$	left cardiac work index
LVSW	g·m	left ventricular stroke work
LVSWI	$g \cdot m/m^2$	left ventricular stroke work index
RCW	kg·m	right cardiac work
RCWI	$kg \cdot m/m^2$	right cardiac work index
RVSW	g·m	right ventricular stroke work
RVSWI	$g \cdot m/m^2$	right ventricular stroke work index
EF	%	ejection fraction

20.6 Renal Calculations

20.6.1 Performing Calculations

1. By selecting [**Main Menu**]→[**Calculations** >>]→[**Renal** >>], or selecting [**Calculations**] QuickKey→[**Renal** >>], you can access the following window.



2. Enter values for calculation.
3. Select the [**Calculate**] button. The system performs a calculation per the current settings and displays the calculated values.
   - ◆ If a calculated value is outside the range, its background will highlight in yellow. You can select [**Range**] to view its normal range in the unit field. For those who are within the range, their unit fields appear blank.
   - ◆ Invalid values are displayed as [---].

In the [**Renal Calculation**] window, you can:

- ■ Trigger a recording by selecting the [**Record**] button. The currently displayed renal calculations are printed out by the recorder.
- ■ Review the previously performed calculations by selecting [**Review**].
- ■ Switch to other calculation window by selecting [**Other Calcs**] and then select the calculation you want.

20.6.2 Entered Parameters

Abbreviation	Unit	Full spelling
URK	mmol/L	urine pstassium
URNa	mmol/L	urinary sodium
Urine	ml/24h	urine
Posm	mOsm/ kgH2O	plasm osmolality
Uosm	mOsm/ kgH2O	urine osmolality
SerNa	mmol/L	serum sodium
Cr	μmol/L	creatinine
UCr	μmol/L	urine creatinine
BUN	mmol/L	blood urea nitrogen
Height	cm	height
Weight	kg	weight

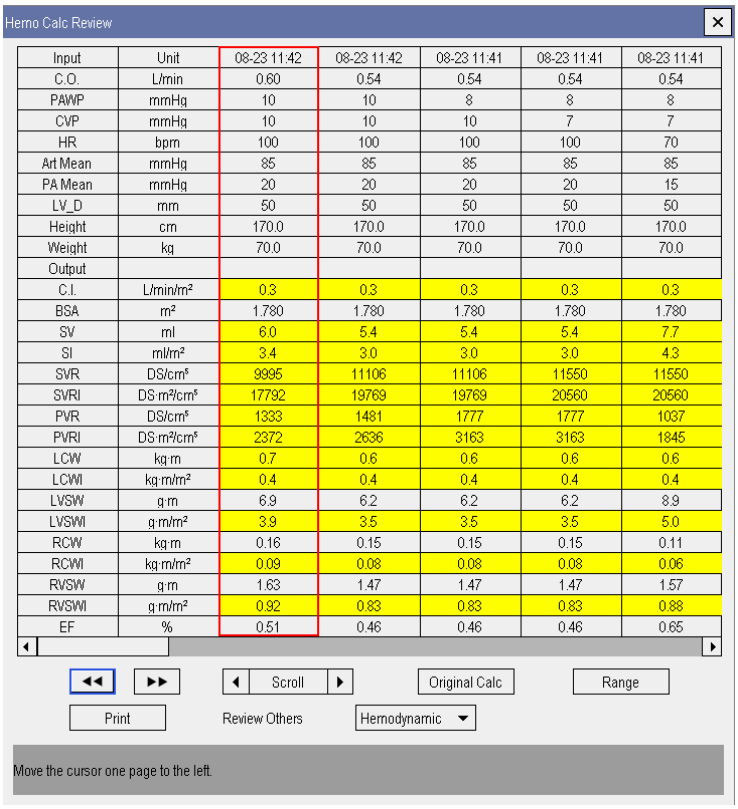
20.6.3 Calculated Parameters

Abbreviation	Unit	Full spelling
URNaEx	mmol/24h	urine sodium excretion
URKEx	mmol/24h	urine potassium excretion
Na/K	%	sodium potassium ratio
CNa	ml/24h	clearance of sodium
Clcr	ml/min	creatinine clearance rate
FENa	%	fractional excretion of sodium
Cosm	ml/min	osmolar clearance
CH2O	ml/h	free water clearance
U/P osm	None	urine to plasma osmolality ratio
BUN/Cr	None*	blood urea nitrogen creatinine ratio
U/Cr	None	urine-serum creatinine ratio

*: BUN/Cr is a ratio under the unit of mol.

20.7 Understanding the Review Window

With the review feature, you can review oxygenation, ventilation, hemodynamic and renal calculations. The review window for each calculation is similar. Take the hemodynamic calculations review window for example, you can access it by selecting [**Review**] in the [**Hemodynamic Calculation**] window.



Input	Unit	08-23 11:42	08-23 11:42	08-23 11:41	08-23 11:41	08-23 11:41
C.O.	L/min	0.60	0.54	0.54	0.54	0.54
PAWP	mmHg	10	10	8	8	8
CVP	mmHg	10	10	10	7	7
HR	bpm	100	100	100	100	70
Art Mean	mmHg	85	85	85	85	85
PA Mean	mmHg	20	20	20	20	15
LV_D	mm	50	50	50	50	50
Height	cm	170.0	170.0	170.0	170.0	170.0
Weight	kg	70.0	70.0	70.0	70.0	70.0
Output						
C.I.	L/min/m²	0.3	0.3	0.3	0.3	0.3
BSA	m²	1.780	1.780	1.780	1.780	1.780
SV	ml	6.0	5.4	5.4	5.4	7.7
SI	ml/m²	3.4	3.0	3.0	3.0	4.3
SVR	DS/cm⁵	9995	11106	11106	11550	11550
SVRI	DS·m²/cm⁵	17792	19769	19769	20560	20560
PVR	DS/cm⁵	1333	1481	1777	1777	1037
PVRI	DS·m²/cm⁵	2372	2636	3163	3163	1845
LCW	kg·m	0.7	0.6	0.6	0.6	0.6
LCWI	kg·m/m²	0.4	0.4	0.4	0.4	0.4
LVSW	g·m	6.9	6.2	6.2	6.2	8.9
LVSWI	g·m/m²	3.9	3.5	3.5	3.5	5.0
RCW	kg·m	0.16	0.15	0.15	0.15	0.11
RCWI	kg·m/m²	0.09	0.08	0.08	0.08	0.06
RVSW	g·m	1.63	1.47	1.47	1.47	1.57
RVSWI	g·m/m²	0.92	0.83	0.83	0.83	0.88
EF	%	0.51	0.46	0.46	0.46	0.65

In this review window:

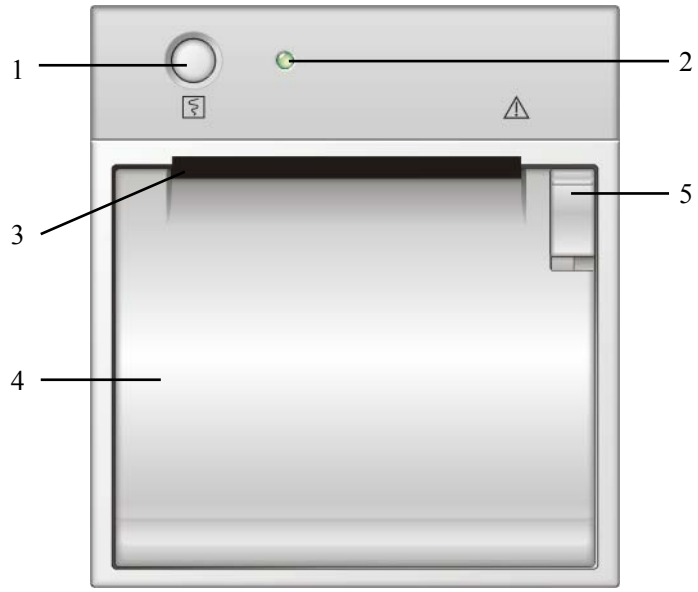
- Up to 10 sets of calculations are stored. This window displays up to 5 sets of calculations at a time. By selecting ◀ or ▶ beside [**Scroll**] or dragging the horizontal scrollbar, you can view more values.
- The values that exceed the range are displayed in yellow background. The [**Unit**] field displays parameter units. If some parameter values are outside of their normal ranges, you can view their normal range in the [**Unit**] field by selecting [**Range**].
- The timeline (the topmost row) lists the times the calculations were performed. You can review an individual calculation by selecting its corresponding time and then selecting [**Original Calc**].

You can switch to other calculation review window by selecting [**Review Others**] and then selecting the calculation you want to review.

21 Recording

21.1 Using a Recorder

The thermal recorder records patient information, measurement numerics, up to three waveforms, etc.



1. Start/Stop key: press to start a recording or stop the current recording.
2. Indicator
   - On: when the recorder works correctly.
   - Off: when the monitor is switched off.
   - Flashes: if an error occurred to the recorder, e.g., the recorder runs out of paper.
3. Paper outlet
4. Recorder door
5. Latch

21.2 Overview of Recording Types

By the way recordings are triggered, the recordings can be classified into the following categories:

- Manually-triggered realtime recordings.
- Timed recordings.
- Alarm recordings triggered by an alarm limit violation or an arrhythmia event.
- Manually-triggered, task-related recordings.

The task-related recordings include:

- Frozen wave recording
- Graphic trends recording
- Tabular trends recording
- NIBP review recording
- Parameter alarm recording
- Arrh. alarm recording
- Wave review recording
- 12-Lead analysis result recording
- Titration table recording
- Hemodynamic calculations recording
- Oxygenation calculations recording
- Ventilation calculations recording
- Renal calculations recording
- oxyCRG recording
- C.O. curve recording
- Respiratory loops recording
- Monitor information recording

NOTE

- **For details about alarm recording, refer to the chapter *6 Alarms*.**
- **For details about task-related recordings, refer to respective sections of this manual.**

21.3 Starting and Stopping Recordings

To manually start a recording, you can either:

- Select the hardkey on the front of either the patient monitor or the recorder module, or
- Select the on-screen [**Record**] QuickKey, or
- Select the [**Record**] button from the current menu or window.

Automatic recordings will be triggered in the following conditions:

- Timed recordings will start automatically at preset intervals.
- If both [**Alarm**] and [**Alm Rec**] for a measurement are set on, an alarm recording will be triggered automatically as alarms occur.

To manually stop a recording, you can either:

- Select the hardkey again, or
- Select the on-screen [**Record**] QuickKey again, or
- Select [**Clear All Tasks**] in the [**Record Setup**] menu.

Recordings stop automatically when:

- The runtime is over.
- The recorder runs out of paper.
- When the recorder has an alarm condition.

21.4 Setting up the Recorder

21.4.1 Accessing the Record Setup Menu

By selecting [**Main Menu**]→[**Record Setup >>**], you can access the [**Record Setup**] menu.

21.4.2 Selecting Waveforms for Recording

The recorder can record up to 3 waveforms at a time. You can select, in turn, [**Waveform 1**], [**Waveform 2**] and [**Waveform 3**] in the [**Record Setup**] menu, and then select the waveforms you want. You can also turn off a waveform recording by selecting [**Off**]. These settings are intended for realtime and scheduled recordings.

21.4.3 Setting the Realtime Recording Length

After starting a realtime recording, the recording time depends on your monitor's settings. In the [**Record Setup**] menu, select [**Length**] and toggle between [**8 s**] and [**Continuous**].

- [**8 s**]: record 8-second waveforms from the current moment.
- [**Continuous**]: record the waveforms from the current moment until stopped manually.

21.4.4 Setting the Interval between Timed Recordings

Timed recordings start automatically at preset intervals. Each recording lasts 8 seconds. To set the interval between timed recordings: in the [**Record Setup**] menu, select [**Interval**] and then select the appropriate setting.

21.4.5 Changing the Recording Speed

In the [**Record Setup**] menu, select [**Paper Speed**] and toggle between [**25 mm/s**] and [**50 mm/s**]. This setting is for all recordings containing waveforms.

21.4.6 Switching Gridlines On or Off

In the [**Record Setup**] menu, select [**Gridlines**] and toggle between [**On**] and [**Off**].

- [**On**]: show gridlines when recording waveforms.
- [**Off**]: hide gridlines when recording waveforms.

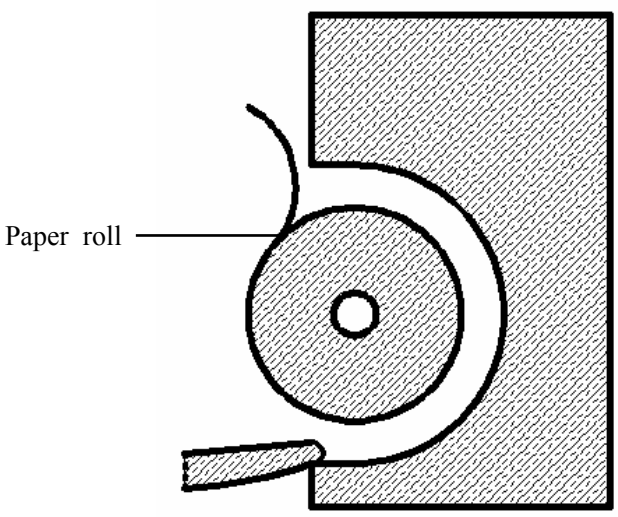
This setting is for all recordings containing waveforms.

21.4.7 Clearing Recording Tasks

In the [**Record Setup**] menu, select [**Clear All Tasks**]. All queued recording tasks are cleared and the current recording is stopped.

21.5 Loading Paper

1. Use the latch at the upper right of the recorder door to pull the door open.
2. Insert a new roll into the compartment as shown below.
3. Close the recorder door.
4. Check if paper is loaded correctly and the paper end is feeding from the top.



⚠CAUTION

- **Use only specified thermal paper. Otherwise, it may cause damage to the recorder's printhead, the recorder may be unable to print, or poor print quality may result.**
- **Never pull the recorder paper with force when a recording is in process. Otherwise, it may cause damage to the recorder.**
- **Do not leave the recorder door open unless you reload paper or remove troubles.**

21.6 Removing Paper Jam

If the recorder works incorrectly or produces unusual sounds, check if there is a paper jam first. If a paper jam is detected, follow this procedure to remove it:

1. Open the recorder door.
2. Take out the paper and tear off the draped part.
3. Reload the paper and close the recorder door.

21.7 Cleaning the Recorder Printhead

If the recorder has been used for a long time, deposits of paper debris may collect on the printhead compromising the print quality and shortening the lifetime of the roller. Follow this procedure to clean the printhead:

1. Take measures against the static electricity such as Disposable Wrist Strap for the work.
2. Open the recorder door and take out the paper.
3. Gently wipe around the printhead using cotton swabs dampened with alcohol.
4. After the alcohol has completely been dried, reload the paper and close the recorder door.

⚠CAUTION

- **Do not use anything that may destroy the thermal element.**
- **Do not add unnecessary force to the thermal head.**

FOR YOUR NOTES

22 Other Functions

22.1 Marking Events

During patient monitoring, some events may exert effects on the patient and as a result change the waveforms or numerics displayed on the monitor. To help analysing the waveforms or numerics at that time, you can mark these events.

To mark an event:

1. Select [**Mark Event**] QuickKey, or [**Main Menu**]→[**Mark Event >>**].
2. Select [**Event A**] and the symbol [**@**] is displayed on the option.

When reviewing graphic trends, tabular trends or full-disclosure waveforms, the event symbols such as A, B, C and D are displayed at the time the event is triggered.

22.2 Analog Output

The patient monitor provides analog output signals to accessory equipment via the Auxiliary Output Connector on the rear of the monitor. To obtain analog output signals, connect the accessory equipment such as an oscillograph, etc. to the monitor and then follow this procedure:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. Select [**Others >>**] to open the [**Others**] menu.
3. Select [**Auxiliary Output**] and then select [**Analog Output**].
4. Select [**Main Menu**]→[**Analog Output Setup>>**].
5. Select [**Analog Output**] and then select [**On**].
6. Select [**Waveform**] and then select a waveform you want to output.

NOTE

- **The analog output feature is seldom applied in clinical applications. You can contact your service personnel for more details.**

22.3 Nurse Call

The patient monitor also provides nurse call signals to a nurse call system connected to the monitor via the Auxiliary Output Connector. To obtain nurse call signals, connect a nurse call system to the monitor and then follow this procedure:

1. Select **[Main Menu]**→[**Maintenance** >>]→[**User Maintenance** >>]→enter the required password.
2. Select [**Others** >>] to access the [**Others**] menu.
3. Select [**Auxiliary Output**] and then select [**Nurse Call**].
4. Select [**Nurse Call Setup**] to change the nurse call settings as follows:

- Select [**Signal Type**] and toggle between [**Pulse**] and [**Continuous**].
  - [**Pulse**]: the nurse call signals are pulse signals and each pulse lasts 1 second. When multiple alarms occur simultaneously, only one pulse signal is outputted. If an alarm occurs but the previous one is not cleared yet, a new pulse signal will also be outputted.
  - [**Continuous**]: the nurse call signal lasts until the alarm ends, i.e. the duration of a nurse call signal equals to that of the alarm condition.
- Select [**Contact Type**] and toggle between [**Normally Open**] and [**Normally Closed**].
  - [**Normally Open**]: select if your hospital's nurse call relay contact is normally open.
  - [**Normally Closed**]: select if your hospital's nurse call relay contact is normally closed.
- Select [**Alm Lev**] and set the alarm level for nurse call-triggering alarms.
- Select [**Alarm Cat.**] and then select the category to which the nurse call-triggering alarms belong.

Alarm conditions are indicated to nurses only when:

- The nurse call system is enabled,
- An alarm that meets your preset requirements occurs, and
- The monitor is not in the alarm paused or silence status.

NOTE

- **If no setting is selected from [Alm Lev] or [Alarm Cat.], no nurse call signal will be triggered whatever alarms occur.**

⚠WARNING

- **Do not rely exclusively on the nurse call system for alarm notification. Remember that the most reliable alarm notification combines audible and visual alarm indications with the patient's clinical condition.**

FOR YOUR NOTES

23 Batteries

23.1 Overview

The patient monitor is designed to operate on battery power during transport or whenever AC power becomes interrupted. The battery is charged whenever the patient monitor is connected to an AC power source regardless of whether or not the patient monitor is currently on. Whenever the AC power is interrupted during patient monitoring, the patient monitor will automatically run power from the internal batteries.

The patient monitor uses two battery packs. If the two batteries have very different charge capacity, the message [**Diff. Battery Voltages**] is displayed. In this case, apply AC power to the patient monitor until the two batteries have approximately equal charge capacity or are both fully charged. You cannot use them before they have approximately equal charge capacity or are fully charged.

On-screen battery symbols indicate the battery status as follows:

- indicates that batteries work correctly. The solid portion represents the current charge level of the batteries in proportion to its maximum charge level.
- indicates that the batteries have low charge level and need to be charged.
- indicates that the batteries are almost depleted and need to be charged immediately.
- indicates that no batteries are installed or only one battery is installed.

The capacity of the internal battery is limited. If the battery capacity is too low, a technical alarm will be triggered and the [**Battery Too Low**] message displayed. At this moment, apply AC power to the patient monitor. Otherwise, the patient monitor will power off automatically before the battery is completely depleted.

NOTE

- **Take out the battery before transport or storage to avoid damaging the battery.**

⚠ WARNING

- **Keep the battery out of children's reach.**
- **Use only specified batteries.**

23.2 Conditioning the Batteries

A battery needs at least two conditioning cycles when it is put into use for the first time. A battery conditioning cycle is one complete, uninterrupted charge of the battery, followed by an uninterrupted discharge of the battery. Batteries should be conditioned regularly to maintain their useful life. Condition the batteries once when they are used or stored for two months, or when their run time becomes noticeably shorter.

To condition the batteries, follow this procedure:

1. Disconnect the patient monitor from the patient and stop all monitoring and measuring procedures.
2. Insert the two batteries in need of conditioning into the battery slots of the patient monitor.
3. Apply AC power to the patient monitor and allow the batteries to charge uninterruptedly for above 6 hours.
4. Remove AC power and allow the patient monitor to run from the batteries until it shuts off.
5. Apply AC power again to the patient monitor and allow the batteries to charge uninterruptedly for above 6 hours.
6. This battery is now conditioned and the patient monitor can be returned to service.

23.3 Checking the Batteries

The performance of the rechargeable batteries may deteriorate over time. To check the performance of the batteries, follow this procedure:

1. Disconnect the patient monitor from the patient and stop all monitoring and measuring procedures.
2. Apply AC power to the patient monitor and allow the batteries to charge uninterruptedly for above 6 hours.
3. Remove AC power and allow the patient monitor to run from the batteries until it shuts off.
4. The operating time of the batteries reflects their performance directly.

If the operating time of the batteries is noticeably shorter than that stated in the specifications, replace the batteries or contact your service personnel.

NOTE

- **Life expectancy of a battery depends on how frequent and how long it is used. For a properly maintained and stored lithium-ion battery, its life expectancy is about 3 years. For more aggressive use models, life expectancy can be less. We recommend replacing lithium-ion batteries every 3 years.**
- **The operating time depends on the configuration and operation. For example, monitoring NIBP repeatedly will also shorten the operating time of the batteries.**

23.4 Installing the Batteries

The patient monitor uses two batteries. You can install the batteries by following this procedure:

1. Turn off the patient monitor and disconnect the power cord and other cables.
2. Place the patient monitor with its back on the desk.
3. Open the battery compartment door.
4. Place the batteries into the slots per the “+” and “-” indications.
5. Close the battery door and place the patient monitor upright.

23.5 Recycling the Batteries

When a battery has visual signs of damage, or no longer holds a charge, it should be replaced. Remove the old battery from the patient monitor and recycle it properly. To dispose of the batteries, follow local laws for proper disposal.

⚠ WARNING

- **Do not disassemble batteries, or dispose of them in fire, or cause them to short circuit. They may ignite, explode, or leak, causing personal injury.**

24 Care and Cleaning

Use only the substances approved by us and methods listed in this chapter to clean or disinfect your equipment. Warranty does not cover damage caused by unapproved substances or methods.
We make no claims regarding the efficacy of the listed chemicals or methods as a means for controlling infection. For the method to control infection, consult your hospital's Infection Control Officer or Epidemiologist.

24.1 General Points

Keep you equipment and accessories free of dust and dirt. To avoid damage to the equipment, follow these rules:

- Always dilute according the manufacturer's instructions or use lowest possible concentration.
- Do not immerse part of the equipment into liquid.
- Do not pour liquid onto the equipment or accessories.
- Do not allow liquid to enter the case.
- Never use abrasive materials (such as steel wool or silver polish), or erosive cleaners (such as acetone or acetone-based cleaners).

⚠ WARNING

- **Be sure to shut down the system and disconnect all power cables from the outlets before cleaning the equipment.**

⚠ CAUTION

- **If you spill liquid on the equipment or accessories, contact us or your service personnel.**

NOTE

- **To clean or disinfect reusable accessories, refer to the instructions delivered with the accessories.**

24.2 Cleaning

Your equipment should be cleaned on a regular basis. If there is heavy pollution or lots of dust and sand in your place, the equipment should be cleaned more frequently. Before cleaning the equipment, consult your hospital's regulations for cleaning the equipment.

Recommended cleaning agents are:

- mile soap (diluted)
- ammonia (diluted)
- sodium hypochlorite bleach (diluted)
- Hydrogen peroxide (3%)
- Ethanol (70%)
- Isopropanol (70%)

To clean your equipment, follow these rules:

1. Shut down the patient monitor and disconnect it from the power line.
2. Clean the display screen using a soft, clean cloth dampened with a glass cleaner.
3. Clean the exterior surface of the equipment using a soft cloth dampened with the cleaner.
4. Wipe off all the cleaning solution with a dry cloth after cleaning if necessary.
5. Dry your equipment in a ventilated, cool place.

24.3 Disinfecting

Disinfection may cause damage to the equipment and is therefore not recommended for this patient monitor unless otherwise indicated in your hospital's servicing schedule. Cleaning equipment before disinfecting is recommended.

The recommended disinfectants include: ethanol 70%, isopropanol 70%, glutaraldehyde-type 2% liquid disinfectants

⚠ CAUTION

- **Never use EtO or formaldehyde for disinfection.**

25 Maintenance

⚠WARNING

- **Failure on the part of the responsible individual hospital or institution employing the use of this equipment to implement a satisfactory maintenance schedule may cause undue equipment failure and possible health hazards.**
- **The safety checks or maintenance involving any disassembly of the equipment should be performed by professional servicing personnel. Otherwise, undue equipment failure and possible health hazards could result.**
- **If you discover a problem with any of the equipment, contact your service personnel or us.**

25.1 Safety Checks

Before every use, after your patient monitor has been used for 6 to 12 months, or whenever your patient monitor is repaired or upgraded, a thorough inspection should be performed by qualified service personnel to ensure the reliability.

Follow these guidelines when inspecting the equipment:

- Make sure that the environment and power supply meet the requirements.
- Inspect the equipment and its accessories for mechanical damage.
- Inspect all power cords for damage, and make sure that there are no breaks in the insulation.
- Make sure that only specified accessories are applied.
- Inspect if the alarm system functions correctly.
- Make sure that the recorder functions correctly and the recorder paper meets the requirements.
- Make sure that the batteries meet the performance requirements.
- Make sure that the patient monitor is good working condition.
- Make sure that the grounding resistance and leakage current meet the requirement.

In case of any damage or abnormity, do not use the patient monitor. Contact the hospital's biomedical engineers or your service personnel immediately.

25.2 Service Tasks

The following tasks are for our qualified service professionals only. Contact a qualified service provider if your patient monitor needs the following services. Clean and disinfect equipment to decontaminate it before testing or maintaining it.

Maintenance schedule	Frequency
Safety checks according to IEC60601-1	At least once every two years, after any repairs where the power supply is replace, or if the patient monitor has been dropped.
Performance assurance for all measurements not listed below	At least once every two years, of if you doubt the measured values.
Defibrillator synchronization	At least once every two years, or as needed.
NIBP leakage test	At least once every two years, or by your hospital policy.
NIBP accuracy test	At least once every two years, or by your hospital policy.
NIBP calibration	At least once every two years, or by your hospital policy.
CO_2 calibration and performance test	At least once every two years, of if you doubt the measured values.
AG calibration	At least once every two years, of if you doubt the measured values.
AG preventative maintenance (pump check, internal fan check, ambient pressure check and so forth as described in the service manual)	At least once every two years, of if you doubt the measured values.

25.3 Checking Monitor and Module Information

To view the information about system start time, selftest, etc., select [**Main Menu**]→[**Maintenance** >>]→[**Monitor Information** >>]. You can print out the information for the convenience of troubleshooting. The information will not be saved during shut down.

You can also view the information about the monitor configuration and system software version by selecting [**Main Menu**]→[**Maintenance** >>]→[**Software Version** >>].

25.4 Calibrating ECG

The ECG signal may be inaccurate due to hardware or software problems. As a result, the ECG wave amplitude becomes greater or smaller. In that case, you need to calibrate the ECG module.

1. Select the ECG parameter window or waveform area→[**Filter**]→[**Diagnostic**].
2. Select [**Main Menu**]→[**Maintenance** >>]→[**Calibrate ECG** >>]. A square wave appears on the screen and the message [**ECG Calibrating**] is displayed.
3. Compare the amplitude of the square wave with the wave scale. The difference should be within 5%.
4. After the calibration is completed, select [**Stop Calibrating ECG**]

You can print out the square wave and wave scale and then measure the difference between them if necessary. If the difference exceeds 5%, contact your service personnel.

25.5 Calibrating the Touchscreen

1. Select [**Cal. Screen**] QuickKey, or [**Main Menu**]→[**Maintenance** >>]→[**User Maintenance** >>]→enter the required password→[**Cal. Touchscreen**].
2. The symbol will, in turn, appear at different positions of the screen.
3. Select, in turn, the central point of the symbol.
4. After the calibration is completed, the message [**Screen Calibration Completed!**] is displayed. Select [**Ok**] to confirm the completion of the calibration.

25.6 Calibrating CO_2

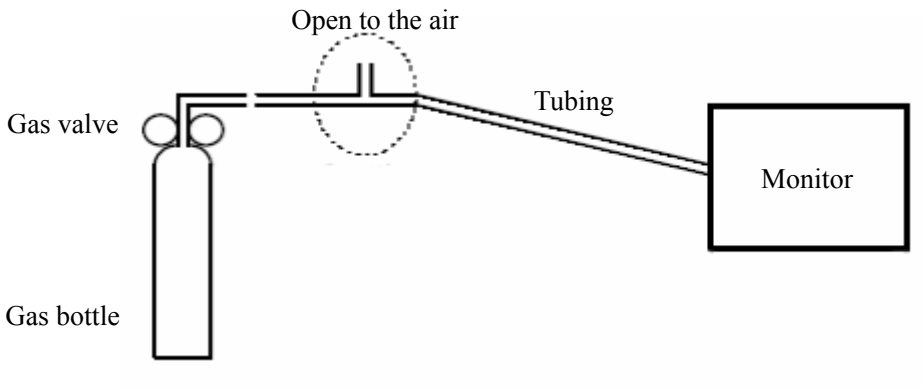
For sidestream and microstream CO_2 modules, a calibration is needed every year or when the measured values have a great deviation. For maintream CO_2 module, no calibration is needed.

Tools required:

- Gas bottle, with 3%, 4%, 5%, 6% or 7% of CO_2.
- T-shape connector
- Tubing

Follow this procedure to perform a calibration:

1. Make sure that the CO_2 module has been warmed up or started up.
2. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance** >>]→enter the required password→[**Maintain CO2 >>**].
3. In the [**Maintain CO2**] menu, select [**Zero**].
4. Connect the gas bottle with the tubing using a T-shape connector as shown below. Check the airway and make sure there are no leaks.



5. Vent the tubing to the CO_2 opening the gas valve.
6. In the [**Calibrate CO2**] menu, enter the vented CO_2 concentration in the [**CO2**] field.
7. In the [**Maintain CO2**] menu, the measured CO_2 concentration, barometric pressure, sensor temperature and current flowrate are displayed. After the measured CO_2 concentration becomes stable, select [**Calibrate CO2**] to calibrate the CO_2 module.
8. If the calibration is finished successfully, the message [**Calibration Completed!**] is displayed. If the calibration failed, the message [**Calibration Failed!**] is displayed. Perform another calibration.
9. Select ✕ to exit the current menu.

25.7 Calibrating AG

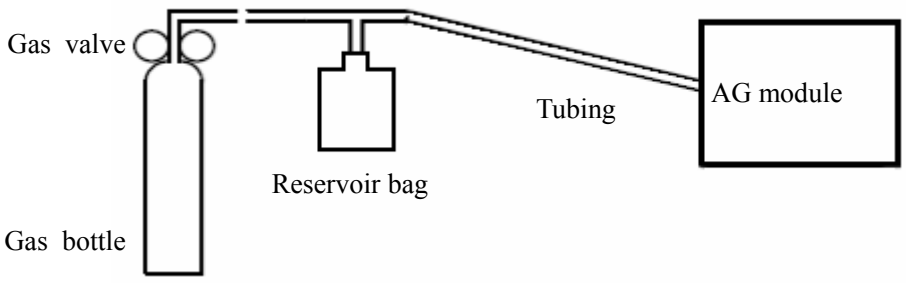
Calibrate the AG module every year or when the measured value has a great deviation.

Tools required:

- Gas bottle, with a certain standard gas or mixture gas. Gas concentration should meet the following requirements: AA>1.5%, CO_2>1.5%, N_2O>40%, O_2>40%, of which AA represents an anesthetic agent.
- T-shape connector
- Tubing
- Reservoir bag

Follow this procedure to perform a calibration:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance** >>]→enter the required password→[**Calibrate AG >>**].
2. Check the airway and make sure that there are no occlusions or leaks.
   - ◆ Vent the tubing to the air and check if the [**Current FlowRate**] and [**Set FlowRate**] are approximately the same. If the deviation is great, it indicates that there is an occlusion in the tubing. Check the tubing for an occlusion.
   - ◆ Block the gas inlet of the tubing. The [**Current FlowRate**] shall fall rapidly and the system prompt that the tubing is blocked. Otherwise, it indicates that there are leakages in the tubing. Check the tubing for leakages.
3. Connect the gas bottle, reservoir bag and the tubing using a T-shape connector as shown in the figure above. Check the airway and make sure there are no leaks.
4. Vent the tubing to a certain standard gas or mixture gas opening the gas valve.



5. In the [**Calibrate AG**] menu, the measured gas concentration and flowrate are displayed.
   - ◆ If the difference between the measured gas concentration and the actual one is very small, a calibration is not needed.

- If the difference is great, you should perform a calibration. Select [**Calibrate >>**] to enter the calibrate menu.

6. Enter the vented gas concentration. If you use only one gas for calibration, set other gases' concentration to 0.
7. Select [**Calibrate**] to start calibration.
8. If the calibration is finished successfully, the message [**Calibration Completed!**] is displayed. If the calibration failed, the message [**Calibration Failed!**] is displayed. Perform another calibration.
9. Select ✕ to exit the current menu.

25.8 Setting up IP Address

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance** >>]→enter the required password.
2. Select [**IP Address Setup >>**] to change IP address settings.

If the patient monitor is connected to a CMS, its IP address should be set up. The user should not change the patient monitor's IP address randomly. If you want to know details about IP address setup, contact the technical personnel in charge of the CMS.

25.9 Entering/Exiting Demo Mode

To enter the Demo mode:

1. Select [**Main Menu**]→[**Maintenance >>**].
2. Select [**Demo >>**]. Enter the required password and then select [**Ok**].

To exit the Demo mode:

1. Select [**Main Menu**]→[**Maintenance >>**].
2. Select [**Exit Demo**] and then select [**Ok**].
3. The patient monitor exits the Demo mode and then shuts down automatically.

⚠WARNING

- **The Demo mode is for demonstration purpose only. To avoid that the simulated data are mistaken for the monitored patient's data, you must not change into Demo mode during monitoring. Otherwise, improper patient monitoring and delayed treatment could result.**

26 Accessories

⚠WARNING

- **Use accessories specified in this chapter. Using other accessories may cause damage to the patient monitor.**
- **Single-use accessories are not designed to be reused. Reuse may cause a risk of contamination and affect the measurement accuracy.**
- **Check the accessories and their packages for any sign of damage. Do not use them if any damage is detected.**

26.1 ECG Accessories

ECG Electrodes

Model	Quantity	Patient Category	Part No.
210	10 pieces	Adult	0010-10-12304
2249	25 pieces		0509-10-00094
2245	25 pieces	Pediatric	9000-10-07469
2258-3	3 pieces	Neonate	900E-10-04880

12-Pin Trunk Cables

Leadwire supported	Compatible with	Type	Patient Category	Part No.
3-leadwire	AHA, IEC	Defibrillator-proof	Pediatric, neonate	0010-30-42720
3-leadwire	AHA, IEC	ESU-proof		0010-30-42724
3/5-leadwire	AHA, IEC	Defibrillator-proof	Adult, pediatric	0010-30-42719
3/5-leadwire	AHA, IEC	ESU-proof		0010-30-42723
12-leadwire	AHA	Defibrillator-proof		0010-30-42721
12-leadwire	IEC	Defibrillator-proof		0010-30-42722

Cable Sets

3-Electrode Cable Sets					
Type	**Compatible with**	**Model**	**Patient Category**	**Part No.**	**Remark**
Clip	IEC	EL6302A	Adult, pediatric	0010-30-42725	/
		EL6304A		0010-30-42732	Long
		EL6306A	Neonate	0010-30-42897	/
		EL6308A	Pediatric	0010-30-42899	/
	AHA	EL6301A	Adult, pediatric	0010-30-42726	/
		EL6303A		0010-30-42731	Long
		EL6305A	Neonate	0010-30-42896	/
		EL6307A	Pediatric	0010-30-42898	/
Snap	IEC	EL6302B	Adult, pediatric	0010-30-42733	/
		EL6308B	Pediatric	0010-30-42901	/
	AHA	EL6301B	Adult, pediatric	0010-30-42734	/
		EL6307B	Pediatric	0010-30-42900	/

5-Electrode Cable Sets					
Type	**Compatible with**	**Model**	**Patient Category**	**Part No.**	**Remark**
Clip	IEC	EL6502A	Adult, pediatric	0010-30-42728	/
		EL6504A		0010-30-42730	Long
	AHA	EL6501A		0010-30-42727	/
		EL6503A		0010-30-42729	Long
Snap	IEC	EL6502B		0010-30-42736	/
	AHA	EL6501B		0010-30-42735	/

12-Electrode Cable Sets					
Type	**Compatible with**	**Model**	**Patient Category**	**Part No.**	**Remark**
Clip	IEC	EL6802A	Adult, pediatric	0010-30-42903	Limb
		EL6804A		0010-30-42905	Chest
	AHA	EL6801A		0010-30-42902	Limb
		EL6803A		0010-30-42904	Chest
Snap	IEC	EL6802B	Adult, pediatric	0010-30-42907	Limb
		EL6804B		0010-30-42909	Chest
	AHA	EL6801B		0010-30-42906	Limb
		EL6803B		0010-30-42908	Chest

26.2 SpO_2 Accessories

Extension Cable

Module type	Part No.
MPM SpO_2 Module	0010-20-42710
Masimo SpO_2 Module	0010-30-42738
Nellcor SpO_2 Module	0010-20-42712

SpO_2 Sensors

MPM SpO2 Module				
Type	**Model**	**Patient Category**		**Part No.**
Disposable	MAX-A	Adult (>30Kg)		0010-10-12202
	MAX-P	Pediatric (10 to 50Kg)		0010-10-12203
	MAX-I	Infant (3 to 20Kg)		0010-10-12204
	MAX-N	Neonate (<3Kg), Adult (>40Kg)		0010-10-12205
Reusable	DS-100A	Adult		9000-10-05161
	OXI-P/I	Pediatric, infant		9000-10-07308
	OXI-A/N	Adult, neonate		9000-10-07336
	518A	Adult, pediatric, neonate (Multi-sites)		518A-30-90226
	512D	Adult (Finger type)		512D-30-90200
	512E			512E-30-90390
	512G	Pediatric (Finger type, soft type)		512G-30-90607
Masimo SpO_2 Module				
Type	**Model**	**Patient Category**	**Remark**	**Part No.**
Disposable	FPS-1901	Pediatric, neonate	LNCS-NeoPt-L	0010-10-42626
	FPS-1862	Neonate	LNCS-Neo-L	0010-10-42627
	FPS-1861	Infant	LNCS-Inf-L	0010-10-42628
	FPS-1860	Pediatric	LNCS-Pdt	0010-10-42629
	FPS-1859	Adult	LNCS-Adt	0010-10-42630
Reusable	FPS-1863	Adult	LNCS DC-I	0010-10-42600
	FPS-1864	Pediatric	LNCS-DCIP	0010-10-42634
	2258	Adult, pediatric, neonate	LNCS YI	0010-10-43016
Nellcor SpO_2 Module				
Type	**Model**	**Patient Category**		**Part No.**
Disposable	MAX-A	Adult (>30Kg)		0010-10-12202
	MAX-P	Pediatric (10 to 50Kg)		0010-10-12203
	MAX-I	Infant (3 to 20Kg)		0010-10-12204
	MAX-N	Neonate (<3Kg), Adult (>40Kg)		0010-10-12205
Reusable	DS-100A	Adult		9000-10-05161
	OXI-P/I	Pediatric, infant		9000-10-07308
	OXI-A/N	Adult, neonate		9000-10-07336

Wavelength emitted by 518A or 518D sensor: red right: 660 nm, infrared light: 940 nm.

Wavelength emitted by 512E or 512G sensor: red light: 660 nm, infrared light: 905 nm.

Wavelength emitted by Masimo sensor: red light: 660 nm, infrared light: 940 nm.

Wavelength emitted by Nellcor sensor: red light:660 nm, infrared light: 890 nm.

26.3 NIBP Accessories

Tubing

Type	Patient Category	Part No.
Reusable	Adult, pediatric	6200-30-09688
	Neonate	6200-30-11560

Reusable Cuff

Model	Patient Category	Measurement Site	Limb Circumference (cm)	Bladder Width (cm)	Part No.
CM1301	Infant	Arm	10 to 19	8.5	0010-30-42745
CM1302	Pediatric		18 to 26	11.5	0010-30-42746
CM1303	Adult		24 to 35	14.5	0010-30-42747
CM1304	Large adult		33 to 47	17.8	0010-30-42748
CM1305	Thigh	Thigh	46 to 66	22.5	0010-30-42749

Disposable Cuff

Model	Patient Category	Measurement Site	Limb Circumference (cm)	Bladder Width (cm)	Part No.
M1872A	Neonate	Arm	7.1 to 13.1	5.1	900E-10-04873
M1870A			5.8 to 10.9	4.3	900E-10-04874
M1868A			4.3 to 8.0	3.2	900E-10-04875
M1868A			3.1 to 5.7	2.5	900E-10-04876

26.4 Temp Accessories

Extension Cable

Type	Model	Temp probe	Part No.
Reusable	MR420B	MR411, MR412	0011-30-37391

Temp Probes

Type	Model	Patient Category	Measurement Site	Part No.
Reusable	MR401B	Adult	Esophageal/Rectal	0011-30-37392
	MR403B		Skin	0011-30-37393
	MR402B	Pediatric, neonate	Esophageal/Rectal	0011-30-37394
	MR404B		Skin	0011-30-37395
Disposable	MR411	Adult, pediatric, neonate	Esophageal/Rectal	0011-30-37398
	MR412		Skin	0011-30-37397

26.5 IBP/ICP Accessories

Accessories Kit No.	Components	Part No.
6800-30-50876	12Pin IBP Cable	0010-30-42740
	Disposable Transducer	0010-10-42638
	Steady Rest for IBP Transducer and Clamp	M90-000133---
	Steady Rest for IBP Transducer and Clamp	M90-000134---
6800-30-50877	12Pin IBP Cable	0010-30-42741
	Disposable Pressure Transducer	6000-10-02107
	Transducer/Manifold Mount	0010-10-12156
ICP		
Model	**Material**	**Part No.**
Gaeltec TYPE.S13	12Pin ICP cable	0010-30-42742
Gaeltec ICT/B	Intracranial Pressure Transducer	0010-10-12151

26.6 C.O. Accessories

Model	Material	Part No.
COC-001-SL	12Pin C.O. cable.	0010-30-42743
SP4042	IT Sensor	6000-10-02079
SP5045	IT Sensor Housing	6000-10-02080
12CC	12CC Control Syringe W/1CC Stop W/Rotator	6000-10-02081
131HF7	Dilution Hose	6000-10-02183

26.7 CO_2 Accessories

Sidestream CO_2 module

Material	Patient Category	Remark	Part No.
DRYLINE Watertrap	Adult, pediatric	Reusable	9200-10-10530
Sampling Line, Adult 2.5m	Adult, pediatric	Disposable	9200-10-10533
Adult Nasal CO_2 Sample Cannula	Adult		M02A-10-25937
Pediatric Nasal CO_2 Sample Cannula	Pediatric		M02A-10-25938
DRYLINE Airway Adapter	/	Straight	9000-10-07486

Microstream CO_2 Module

Disposable Airway Sampling Line			
Model	**Patient Category**	**Remark**	**Part No.**
XS04620	Adult, pediatric	/	0010-10-42560
XS04624		Humidified	0010-10-42561
007768		Long	0010-10-42563
007737		Long, humidified	0010-10-42564
006324	Infant, Neonate	Humidified	0010-10-42562
007738		Long, humidified	0010-10-42565

Disposable Nasal Sampling Line			
Model	**Patient Category**	**Remark**	**Part No.**
009818	Adult, intermediate	/	0010-10-42566
009822		Plus O2	0010-10-42568
009826		Long, plus O2	0010-10-42570
008174	Adult	/	0010-10-42577
008177		Humidified	0010-10-42572

Disposable Nasal Sampling Line			
Model	**Patient Category**	**Remark**	**Part No.**
008180		Humidified, plus O_2	0010-10-42575
007266	Pediatric	/	0010-10-42567
008175		/	0010-10-42578
008178		Humidified	0010-10-42573
008181		Humidified, plus O_2	0010-10-42576
007269		Plus O_2	0010-10-42569
007743		Long, plus O_2	0010-10-42571
008179	Infant, Neonate	Humidified	0010-10-42574

Mainstream CO_2 Module

Material	**Model**	**Patient Category**	**Remark**	**Part No.**
Airway adapter	6063	Adult	Disposable	0010-10-42662
	6421		Disposable, with mouthpiece	0010-10-42663
	7007	Adult, pediatric	Reusable	0010-10-42665
	6312	Neonate	Disposable	0010-10-42664
	7053		Reusable	0010-10-42666
Mask	9960STD	Adult	/	0010-10-42670
	9960LGE		Adult large	0010-10-42671
	9960PED	Pediatric	/	0010-10-42669
Cable management straps	/	/	/	0010-10-42667
Sensor holding clips	/	/	/	0010-10-42668
Sensor	/	Adult, pediatric, neonate	Reusable	6800-30-50760

26.8 AG Accessories

Material	Patient Category	Remark	Part No.
Watertrap	Adult, pediatric	Reusable	9200-10-10530
	Neonate		9200-10-10574
Sampling line	Adult, pediatric	Disposable	9200-10-10533
	Neonate		9200-10-10555
Airway adapter	Adult, pediatric, neonate	Disposable, straight	9000-10-07486
	Adult, pediatric, neonate	Disposable, elbow	9000-10-07487

26.9 ICG Accessories

Material	Part No.
BioZ tect ICG sensor	0010-10-42675
BioZ Dx Patient Cable	0010-10-42676
BioZ Dx Lead Wire Array	0010-10-42677

26.10 BIS Accessories

Material	Patient Category	Part No.
BIS sensor	Adult	0010-10-42672
BIS sensor	Pediatric	0010-10-42673
BIS Cable	Adult, pediatric	6800-30-50761

26.11 RM Accessories

Material	Patient Category	Remark	Part No.
Flow sensor	Adult, pediatric	Reusable	0010-30-42678
	Adult, pediatric	Disposable	0010-30-42679
	Neonate	Disposable	0010-30-42680
RM connector	/	/	6800-20-50328

26.12 Others

Material	Part No.
USB keyboard	0000-10-11060
USB mice	0000-10-11061
Lithium battery	M05-010002-06
3-core power cord	509B-10-05996
Grounding cable	1000-21-00122
Defibrillator synchronization cable	6800-20-50781
Nurse call cable	8000-21-10361

A Product Specifications

A.1 Monitor Safety Specifications

A.1.1 Classifications

The patient monitor is classified, according to IEC60601-1:

Components	Type of protection against electrical shock	Degree of protection against electrical shock	Degree of protection against harmful ingress of water	Degree of protection against hazards of explosion	Mode of operation
Main unit	I	Not marked	Ordinary	Not suitable	Continuous
Secondary display		Not marked			
MPM	NA	CF			
IBP module					
C.O. module					
ICG module					
BIS module		BF			
AG module					
CO_2 module					
RM module					
SMR		Not marked			

- I: Class I equipment
- BF: Type BF applied part
- CF: Type CF applied part
- NA: Not applicable
- Ordinary: Ordinary equipment (enclosed equipment without protection against ingress of water)
- Not suitable: Equipment not suitable for use in the presence of a flammable anesthetic mixture with air with oxygen or nitrous oxide.

A.1.2 Environmental Specifications

Main unit, MPM, IBP module, C.O. module, Recorder		
Item	**Operating conditions**	**Storage conditions**
Temperature (ºC)	5 to 40	-20 to 60
Relative humidity (noncondensing)	15 to 95%	10 to 95%
Barometric (kPa)	70.0 to 106.0	22.0 to 107.4

Microstream CO_2 module		
Item	**Operating conditions**	**Storage conditions**
Temperature (ºC)	0 to 40	-20 to 60
Relative humidity (noncondensing)	15 to 95%	10 to 95%
Barometric (kPa)	430 to 795	430 to 795

Sidestream CO_2 module		
Item	**Operating conditions**	**Storage conditions**
Temperature (ºC)	5 to 35	-20 to 60
Relative humidity (noncondensing)	15 to 95%	15 to 95%
Barometric (kPa)	428 to 790	428 to 790

Mainstream CO_2 module		
Item	**Operating conditions**	**Storage conditions**
Temperature (ºC)	10 to 40	-10 to 50
Relative humidity (noncondensing)	10 to 90%	0 to 90%
Barometric (kPa)	400 to 850	400 to 850

AG module		
Item	**Operating conditions**	**Storage conditions**
Temperature (ºC)	10 to 40	-20 to 70
Relative humidity (noncondensing)	15 to 95%	10 to 95%
Barometric (kPa)	525 to 900	525 to 900

RM module		
Item	**Operating conditions**	**Storage conditions**
Temperature (ºC)	5 to 40	-20 to 60
Relative humidity (noncondensing)	15 to 95%	10 to 95%
Barometric (kPa)	500 to 800	500 to 800

BIS module		
Item	**Operating conditions**	**Storage conditions**
Temperature (ºC)	0 to 40	-20 to 50
Relative humidity (noncondensing)	10 to 95%	10 to 95%
Barometric (kPa)	356 to 760	356 to 760

ICG module		
Item	**Operating conditions**	**Storage conditions**
Temperature (ºC)	10 to 40	0 to 50
Relative humidity (noncondensing)	15 to 95%	15 to 95%
Barometric (kPa)	619 to 780	619 to 780

A.1.3 Power requirements

Line voltage	100 to 240 VAC
Frequency	2.8 to 1.6 A
Current	50/60 Hz
Fuse	Time-lag 250V 4A

A.2 Physical Specifications

Components	Weight	Size	Equipment type
Main unit	<14.5 kg	400×370×193 mm	Includes a 17" touchscreen, an MPM, an AG module, two lithium batteries, a recorder, CF components, but no accessories.
SMR	<1.8 kg	142×402×151 mm	With no module inserted
MPM	<0.63 kg	136.5×80.5×102 mm	
IBP module	<0.25 kg	136.5×40×102 mm	
C.O. module	<0.25 kg	136.5×40×102 mm	
Sidestream CO_2 module	<0.48 kg	136.5×80.5×102 mm	
Microstream CO_2 module	<0.73 kg	136.5×40×102 mm	
Mainstream CO_2 module	<0.50 kg	136.5×40×102 mm	
M-type AG module	<1.75 kg	136.5×121×102 mm	With O_2 and BIS modules
A-type AG module	<1.75 kg	136.5×121×102 mm	With O_2 and BIS modules
ICG module	<0.35 kg	136.5×40×102 mm	
BIS module	<0.25 kg	136.5×40×102 mm	
RM module	<0.27 kg	136.5×40×102 mm	

A.3 Hardware Specifications

A.3.1 Display

Host display	
Screen type	Color TFT LCD
Screen Size (diagonal)	17"
Resolution	1280×1024 pixels
External display	
Screen type	Medical-grade TFT LCD
Screen Size	15", 17" or above
Resolution	1024×768 pixels
EMC	MPR II, CISPR 11B
Third certificate	UL, C-UL, TUV, CE, FCC, UL 60601-1

A.3.2 Recorder

Method	Thermal dot array
Horizontal resolution	16 dots/mm (25 mm/s paper speed)
Vertical resolution	8 dots/mm
Paper width	50 mm
Paper length	20 m
Paper speed	25 mm/s, 50 mm/s
Number of waveform channels	1, 2, or 3 (optional)

A.3.3 Battery

Size	147.5×60.4×23.8 mm
Weight	350 g
Number of batteries	2
Battery Type	Chargeable Lithium-Ion
Voltage	11.1 VDC
Capacity	4500 mAh
Run time	2 h 2 new, fully charged batteries at 25°C under typical (with SpO_2 sensor but no ECG, Temp and IBP cables connected, and auto NIBP measurements at intervals of 15 minutes) conditions
Charge time	6 h at most (in standby mode)
Shutdown delay	10 to 15 min (after a low battery alarm first occurs)

A.3.4 LEDs

Physiological alarm lamp	1 (two color coded: yellow and red)
Technical alarm lamp	1 (blue)
Power on LED	1 (green)
AC power LED	1 (green)
Battery LED	1 (green)

A.3.5 Audio Indicator

Speaker	Give alarm tones, key tones, QRS tones; support PITCH TONE and multi-level tone modulation; alarm tones comply with IEC60601-1-8.

A.3.6 Monitor Interface Specifications

Power	1 AC power input connector
Wire network	2 RJ45 connector, 100-Base-TX, IEEE 802.3
USB	10 connectors, USB 1.1
SMR connector	1 connector, not standard USB
CF	50-pin CF revision 2.0 connector
Video interface	1 connector, standard DVI-D
Auxiliary output	1 connector, standard BNC, the common connector of nurse call signals and analog output signals
Equipotential Grounding Terminal	1
Defib Sync Connector	1 connector, RJ11

A.3.7 Outputs

Auxiliary Output	
Standard	Meets the requirements of EC60601-1 for short-circuit protection and leakage current
Output impedance	50Ω rating
ECG Analog Output	
Bandwidth (-3dB; reference frequency: 10Hz)	Diagnostic mode: 0.05 to 100 Hz Monitor mode: 0.5 to 40 Hz Surgical mode: 1 to 20 Hz
Output signal range	-2.5 to 2.5 V
Max transmission delay	25 ms (in diagnostic mode, and with Notch off)
Sensitivity	1V/mV ±5%
PACE rejection/enhancement	No pace rejection or enhancement
IBP Analog Output	
Bandwidth (-3dB; reference frequency:1Hz)	0 to 12.5 Hz
Max transmission delay	55 ms (with Notch off)
Sensitivity	1 V/100 mmHg ±5%
Nurse Call Signal	

Output mode	Relay
Electrical requirements	≤60W, ≤2A, ≤36VDC, ≤25VAC
Isolation voltage	1500 VAC
Contact type	Normally open or normally contact (optional)
Defib Sync Pulse	
Output impedance	50 Ω
Max time delay	35 ms (R-wave peak to leading edge of pulse)
Amplitude	High level: 3.5 to 5 V, providing a maximum of 1 mA output current; Low level: < 0.5 V, receiving a maximum of 5 mA input current.
Pulse width	100 ms ±10%
Limited current	15 mA rating
Rising and falling time	<1 ms
Digital video output (DVI-D connector)	
Video signals	Single Link TMDS
DDC	Signals 12C compliant

A.4 Data Storage

Trends	Trends: 120 hours, at 1 min resolution Minitrends: 1 hour, at 1 s resolution
Parameter alarms	100 alarms and related parameter waveforms. The waveform recording length can be 8s, 16s or 32s.
Arrh. events	100 arrhythmia events and relate waveforms. The waveform recording length can be 8s, 16s or 32s.
NIBP measurements	1000 sets
12-lead analysis results	40 sets
Full-disclosure waveforms	The storage time depends on the waveforms stored and the number of stored waveforms.

A.5 Measurement Specifications

A.5.1 ECG

ECG			
Standards	Meet standards of EC11, EC13, EN60601-2-27/IEC60601-2-27 and IEC60601-2-25		
Lead set	3-lead: I, II, III 5-lead: I, II, III, aVR, aVL, aVF, V 12-lead: I, II, III, aVR, aVL, aVF, V1 to V6		
ECG standard	AHA, IEC		
Display sensitivity	1.25 mm/mV (X0.125), 2.5 mm/mV (X0.25), 5 mm/mV (X0.5), 10 mm/mV (X1), 20 mm/mV (X2), Auto		
Sweep speed	12.5 mm/s, 25 mm/s, 50 mm/s		
Bandwidth (-3dB)	Diagnostic mode: 0.05 to 150 Hz Monitor mode: 0.5 to 40 Hz Surgical mode: 1 to 20 Hz		
Common mode rejection ratio (with Notch off)	Diagnostic mode: ≥90 dB Monitor mode: ≥105 dB Surgical mode: ≥105 dB		
Notch	50/60 HZ Monitor and surgical mode: Notch turns on automatically. Diagnostic mode: Notch is turned on/off manually		
Differential input impedance	≥5 MΩ		
Input signal range	±8 mV (peak-to-peak value)		
Electrode offset potential tolerance	±500 mV		
Baseline recovery time	<5s (after defibrillation)		
Patient leakage current	<10 uA		
Calibration signal	1mV (peak-to-peak value)		
HR			
Measurement range	3-, 5-, and 12-lead ECG	Neonate:	15 to 350 bpm
		Pediatric:	15 to 350 bpm
		Adult:	15 to 300 bpm
	12-lead analysis	Adult, pediatric:	30 to 120 bpm
Resolution	1 bpm		

Accuracy	3-, 5-, and 12-lead ECG: ±1 bpm or ±1%, whichever is greater. 12-lead analysis: ±2 bpm
Sensitivity	200 μ V (lead II)
Response time to heart rate change	Meets the requirements of ANSI/AAMI EC13-2002: Section 4.1.2.1 f). From 80 to 120 bpm: less than 11 s From 80 to 40 bpm: less than 11 s
Time to alarm for tachycardia	Meets the requirements of ANSI/AAMI EC13-2002: section 4.1.2.1 g). Waveform 4ah - range: 11 s 4a - range: 11 s 4ad - range: 11 s Waveform 4bh - range: 11 s 4b - range: 11 s 4bd - range: 11 s
Pace Pulse	
Pace pulse markers	Pace pulses meeting the following conditions are labelled with a PACE marker: Amplitude: ±2 to ±700 mV Width: 0.1 to 2 ms Rise time: 10 to 100 μs
Pace pulse rejection	When tested in accordance with the ANSI/AAMI EC13-2002: Sections 4.1.4.1 and 4.1.4.3, the heart rate meter rejects all pulses meeting the following conditions. Amplitude: ±2 to ±700 mV Width: 0.1 to 2 ms Rise time: 10 to 100 μs
ST Segment Analysis	
Measurement range	-2.0 to 2.0 mV
Accuracy	-0.8 to 0.8 mV: ±0.02 mV or ±10%, whichever is greater. Beyond this range: Not specified.
Refreshing rate	10s
Arrhythmia Analysis	
Events	Asystole, Vfib/Vtac, PVC, Couplet, VT>2, Bigeminy, Trigeminy, R on T, Missed Beats, Tachy, Brady, PNC and PNP

A.5.2 Resp

Technique	Trans-thoracic impedance
Lead	Options are lead I and II. The default is lead II.
Excitation current	<300 μA
Respiration impedance range	0.3 to 5 Ω
Baseline impedance range	200 to 2500 Ω (using an ECG cable with 1kΩ resistance)
Differential input impedance	>2.5 MΩ
Bandwidth	0.2 to 2 Hz (-3 dB)
Sweep speed	6.25, 12.5 or 25 mm/s
Respiration Rate	
Measurement range	Adult: 0 to 120 rpm Pediatric, neonate: 0 to 150 rpm
Resolution	1 rpm
Accuracy	7 to 150 rpm: ±2 rpm or ±2%, whichever is greater 0 to 6 rpm: Not specified.
Apnea alarm time	10 s, 15 s, 20 s, 25 s, 30 s, 35 s, 40 s

A.5.3 SpO_2

MPM SpO_2 Module

Standards	Meet standards of ISO9919 and ASTM1415
SpO_2	
Measurement range	0 to 100%
Resolution	1%
Accuracy	70 to 100%: ±2% (measured without motion in adult/pediatric mode) 70 to 100%: ±3% (measured with motion in neonate mode) 70 to 100%: ±3% (measured with motion) 0% to 69%: Not specified.
Refreshing rate	1s
PR	
Measurement range	20 to 254 bpm
Resolution	1bpm
Accuracy	±3 bpm (measured without motion) ±5 bpm (measured with motion)
Refreshing rate	1s

Masimo SpO_2 Module

SpO_2	
Measurement range	1 to 100%
Resolution	1%
Accuracy	70 to 100%: ±2% (measured without motion in adult/pediatric mode) 70 to 100%: ±3% (measured with motion in neonate mode) 70 to 100%: ±3% (measured with motion) 0% to 69%: Not specified.
Refreshing rate	1s
PR	
Measurement range	25 to 240 bpm
Resolution	1 bpm

Accuracy	±3 bpm (measured without motion) ±5 bpm (measured with motion)
Refreshing rate	1s
Low Perfusion	
Conditions	Pulse amplitude: >0.02% Light penetration: >5%
SpO_2 accuracy	±2%
PR accuracy	±3 bpm

Nellcor SpO_2 Module

Parameter	**Specifications**		
SpO_2 measurement range and accuracy	Sensor	Range	Precision*
	MAX-A, MAX-AL, MAX-N MAX-P, MAX-I, MAX-FAST	70 to 100% 0% to 69%	±2% Not specified.
	OxiCliq A, OxiCliq N OxiCliq P, OxiCliq I	70 to 100% 0% to 69%	±2.5% Not specified.
	D-YS, DS-100A, OXI-A/N, OXI-P/I	70 to 100% 0% to 69%	±3% Not specified.
	MAX-R, D-YSE, D-YSPD	70 to 100% 0% to 69%	±3.5% Not specified.
PR measurement range and accuracy	20 to 250 bpm:	±3 bpm	
	251 to 300 bpm:	Not specified.	
Refreshing rate	1s		
*: When the SpO_2 sensor is applied for neonatal patients as indicated, the specified accuracy range is increased by ±1%, to compensate for the theoretical effect on oximeter measurements of fetal hemoglobin in neonatal blood.			

A.5.4 NIBP

Standards	Meet standards of EN60601-2-30/IEC60601-2-30, EN1060-1, EN1060-3 and SP10			
Technique	Oscillometric			
Mode of operation	Manual, Auto and STAT			
Auto mode repetition intervals	1, 2, 3, 4, 5, 10, 15, 30, 60, 90, 120, 180, 240 or 480 min			
STAT mode cycle time	5 min			
Max measurement time	Adult, pediatric: 180 s Neonate: 90 s			
Heart rate range	40 to 240 bpm			
Measurement ranges (mmHg)		Adult	Pediatric	Neonate
	Systolic:	40 to 270	40 to 200	40 to 135
	Diastolic:	10 to 210	10 to 150	10 to 100
	Mean:	20 to 230	20 to 165	20 to 110
Accuracy	Max mean error: ±5 mmHg Max standard deviation: 8 mmHg			
Resolution	1mmHg			
Initial cuff inflation pressure	Adult: 178±5 mmHg Pediatric: 133±10 mmHg Neonate: 87±5 mmHg			
Software overpressure protection	Adult: 297±3 mmHg Pediatric: 240±3 mmHg Neonate: 147±3 mmHg			
Hardware overpressure protection	Adult: 330±5 mmHg Pediatric: 330±5 mmHg Neonate: 165±5 mmHg			

A.5.5 Temp

Standards	Meet standard of EN12470-4
Technique	Thermal resistance
Measurement range	0 to 50°C (32 to 122°F)
Resolution	0.1°C
Accuracy	±0.1°C or ±0.2°F (without probe)
Refreshing rate	1s
Minimum time for accurate measurement	Body surface: <100s Body cavity: <80s

A.5.6 IBP

Standards	Meet standard of EN60601-2-34/IEC60601-2-34.	
Technique	Direct invasive measurement	
IBP		
Measurement range	ART	0 to 300 mmHg
	PA	-6 to 120 mmHg
	CVP/RAP/LAP/ICP	-10 to 40 mmHg
	P1/P2	-50 to 300 mmHg
Resolution	1 mmHg	
Accuracy	±2% or ±1mmHg, whichever is greater	
Refreshing rate	1s	
Pressure transducer		
Excitement voltage	5 VDC, ±2%	
Sensitivity	5 uV/V/mmHg	
Impedance range	300 to 3000 Ω	

A.5.7 C.O.

Measurement method	Thermodilution method	
Measurement range	C.O.:	0.1 to 20 L/min
	BT:	23 to 43°C
	TI:	0 to 27°C
Resolution	C.O.: BT, TI:	0.1 L/min 0.1°C
Accuracy	C.O.: BT, TI:	±5% or ±0.1 L /min ±0.1°C (without sensor)
Alarm range	BT:	23 to 43°C

A.5.8 CO_2

Measurement mode	Sidestream, microstream, mainstream
Technique	Infrared absorption

Sidestream CO_2 Module

Standard	Meet standard of ISO9918, ISO 21647 and F1456
CO_2 Measurement range	0 to 99 mmHg
Accuracy*	0 to 40 mmHg: ±2 mmHg 41 to 76 mmHg: ±5% of the reading 77 to 99 mmHg: ±10% of the reading
Resolution	1 mmHg
Response time	<240ms (10% to 90%)
Gas sampling delay time	<2s (measured with a 7-feet sample line having an inner diameter of 0.055 inch, and a sample flow rate of 150ml/min)
awRR measurement range	0 to 120 rpm
awRR measurement precision	0 to 70 rpm: ±2 rpm 70 to 99 rpm: ±5 rpm
Apnea time	10s, 15s, 20s, 25s, 30s, 35s, 40s

* Accuracy applies for the following conditions:

1. Measurements begin after the CO_2 module warms up;
2. Ambient pressure is from 750 to 760 mmHg, and ambient temperature from 22 to 28ºC;
3. The measured gas is a dry gas and the balance gas N_2;
4. Gas sample flow rate is 150ml/min, respiration rate is 30 rpm with a fluctuation between ±3 rpm, and I:E is 1:2.

For other conditions, the accuracy complies with EN864 or ISO9918: ±4mmHg (0 to 40mmHg) or 12% of the reading (41 to 99mmHg).

Microstream CO_2 Module

Standard	Meet standard of EN864 and ISO9918
CO_2 Measurement range	0 to 99 mmHg
Precision*	0 to 38 mmHg: ±2 mmHg 39 to 99 mmHg: ±5% of the reading+0.08% of (the reading-38)
* Accuracy applies for respiration rate up to 80 rpm. For respiration rate above 80 rpm, the accuracy complies with EN 864/ISO 9918 (4 mmHg or ±12% of the reading, whichever is greater) for $EtCO_2$ exceeding 18 mmHg. For respiration rate above 60 rpm, the above accuracy can be achieved by using the CapnoLine H Set for Infant/Neonatal. In the presence of interfering gases, the above accuracy is maintained to within 4% according to EN864 Section Eleven, Part 101.	
Resolution	1 mmHg
Initialization time	30 s (typical)
Response time	2.9 s (typical) (The response time is the sum of the rise time and the delay time when using a FilterLine of standard length) Rise time: <190ms (10% to 90%) Delay time: 2.7s (typical)
awRR measurement range	0 to 150 rpm
awRR measurement accuracy	0 to 70 rpm: ±1 rpm 70 to 120 rpm: ±2 rpm 121 to 150 rpm: ±3 rpm
Apnea alarm time	10s, 15s, 20s, 25s, 30s, 35s, 40s

Mainstream CO_2 Module

Standard	Meet standard of EN864 and ISO9918
CO_2 Measurement range	0 to 150 mmHg
Accuracy	0 to 40 mmHg: ±2 mmHg 41 to 70 mmHg: ±5% of the reading 71 to 100 mmHg: ±8% of the reading 101 to 150 mmHg: ±10% of the reading
Resolution	0 to 69 mmHg: 0.1 mmHg 70 to 150 mmHg: 0.25 mmHg
Response time	<60ms
awRR measurement range	0 to 150 rpm
awRR measurement accuracy	1 rpm

A.5.9 AG

Standards	Meet standard of ISO 21647		
Technique	Infrared absorption		
Warm-up time	Warming up status:	45 s	
	Ready-to-measure status:	10 min	
Sample flow rate	Adult, pediatric:	120, 150, 200 ml/min	
	Neonate:	70, 90, 120 ml/min	
	Accuracy:	±10 ml/min or ±10%, whichever is greater	
Measurement range	CO_2:	0 to 30%	
	O_2:	0 to 100%	
	N_2O:	0 to 100%	
	Des:	0 to 30%	
	Sev:	0 to 30%	
	Enf:	0 to 30%	
	Iso:	0 to 30%	
	Hal:	0 to 30%	
	awRR:	2 to 100 rpm	
Resolution	CO_2:	1 mmHg	
	awRR:	1 rpm	
Accuracy (warming-up status)	CO_2:	$\pm 0.3\%_{ABS}$	
	N_2O:	$\pm(8\%_{REF}+2\%_{ABS})$	
	Other anesthetic gases:	$8\%_{REF}$	
Accuracy (ready-to-measure status)	Gases	Range ($\%_{REL}$)	Accuracy ($\%_{ABS}$)
	CO_2	0 to 1	±0.1
		1 to 5	±0.2
		5 to 7	±0.3
		7 to 10	±0.5
		>10	Not specified
	N_2O	0 to 20	±2
		20 to 100	±3
	O_2	0 to 25	±1
		25 to 80	±2
		80 to 100	±3
	Des	0 to 1	±0.15
		1 to 5	±0.2
		5 to 10	±0.4

		10 to 15	±0.6
		15 to 18	±1
		>18	Not specified
	Sev	0 to 1	±0.15
		1 to 5	±0.2
		5 to 8	±0.4
		>8	Not specified
	Enf, Iso, Hal	0 to 1	±0.15
		1 to 5	±0.2
		>5	Not specified
	awRR	2 to 60 rpm	±1 rpm
		>60 rpm	Not specified
Apnea alarm time	20 to 40 s		
Refreshing rate	1s		
Rise time*	CO_2	≤250ms (fall time: 200ms)	
	N_2O	≤250ms	
	O_2	≤600ms	
	Hal, Iso, Sev, Des	≤300ms	
	Enf	≤350ms	
Rise time**	CO_2	≤250ms (fall time: 200ms)	
	N_2O	≤250ms	
	O_2	≤500ms	
	Hal, Iso, Sev, Des	≤300ms	
	Enf	≤350ms	
Delay time	<4s		

*: 10 % to 90 %, gas sample flow rate 120ml/min, using the DRYLINE™ watertrap and neonatal DRYLINE™ sampling line (2.5m)

**: 10 % to 90 %, gas sample flow rate 200ml/min, using the DRYLINE™ water trap and adult DRYLINE™ sampling line (2.5m).

A.5.10 ICG

Technique	Thoracic electrical bioimpedance (TEB)
Measurement range	SV: 5 to 250 ml/beat HR: 44 to 185 bpm C.O.: 1.4 to 15 L/min
Accuracy	SV: Not specified. HR: ±2 bpm C.O.: Not specified.

A.5.11 BIS

Standards	Meet standard of IEC 60601-2-26
Technique	Bispectral index
Measured parameters	EEG BIS: 0 to 100
Calculated parameters	SQI: 0 to 100% EMG, SR, DSA, TP
Impedance range	0 to 999 k Ω
Sweep speed	12.5, 25 or 50 mm/s
Input impedance	>5 M Ω
Noise (RTI)	<0.3 μV (0.25 to 50 Hz)
Input signal range	±1 mV
EEG bandwidth	0.25 to 110 Hz
Patient leakage current	<10 μA

A.5.12 RM

Technique	Flow sensor	
Frequency response	≥30Hz	
Dead space	<11ml	
Flow		
Measurement range	Adult/pediatric: ± (2 to 120) L/min Neonate: ± (0.5 to 30) L/min	
Accuracy	25 ml/s or ±10% of the reading, whichever is greater	
Resolution	0.1 L/min (minimum)	
Paw		
Measurement range	-20 to 120 cmH_2O	
Accuracy	±3% of the reading	
Resolution	0.1 cmH_2O	
MVe/MVi		
Measurement range	Adult, Pediatric: 2 to 60 L/min Neonatal: 0.5 to 15 L/min	
Accuracy	±5%×reading	
TVe/TVi		
Measurement range	Adult, Pediatric: 100 to 1500 ml Neonatal: 20 to 500 ml	
Resolution	1 ml	
Accuracy	±15 ml or ±10%×reading, whichever is greater.	
RR (RM)		
Measurement range	4 to 120 rpm	
Accuracy	4 to 99 rpm ±1 rpm 100 to 120 rpm ±2 rpm	
Calculated Parameters		
	Measurement range	Measurement accuracy
I:E	12:1 to 1:12	<±5% of the reading
FEV1.0%	0 to 100%	
Pmean	0 to 120 cmH_2O	
TV	20 to 1500 ml	
MV	2 to 60 L	
PEEP	0 to 120 cmH_2O	

PEF	2 to 120 L/min	
PIF	2 to 120 L/min	
PIP	0 to 120 cmH_2O	
Pplat	0 to 120 cmH_2O	
Compl	0 to 200 ml/cmH_2O	
Raw	0 to 100 $cmH_2O/L/s$	
RSBI	0 to 4095 rpm/L	
NIP	0 to 120 cmH_2O	
WOB	0 to 640 J	

FOR YOUR NOTES

B EMC

The patient monitor meets the requirements of IEC 60601-1-2:2001

Note

- **Using accessories, transducers and cables other than those specified may result in increased electromagnetic emission or decreased electromagnetic immunity of the patient monitoring equipment.**
- **The patient monitor or its components should not be used adjacent to or stacked with other equipment. If adjacent or stacked use is necessary, the patient monitor or its components should be observed to verify normal operation in the configuration in which it will be used.**
- **The patient monitor needs special precautions regarding EMC and needs to be installed and put into service according to the EMC information provided below.**
- **Other devices may affect this monitor even though they meet the requirements of CISPR.**
- **When the inputted signal is below the minimum amplitude provided in technical specifications, erroneous measurements could result.**

Guidance and Declaration - Electromagnetic Emissions		
The patient monitor is suitable for use in the electromagnetic environment specified below. The customer or the user of the patient monitor should assure that it is used in such an environment.		
Emission tests	**Compliance**	**Electromagnetic environment - guidance**
Radio frequency (RF) emissions CISPR 11	Group 1	The patient monitor uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11	Class A	The patient monitor is suitable for use in all establishments other than domestic and those indirectly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions IEC61000-3-2	Class A	
Voltage fluctuations/flicker emissions IEC61000-3-3	Compliance	

Guidance and Declaration - Electromagnetic Immunity			
The patient monitor is suitable for use in the electromagnetic environment specified below. The customer or the user of the patient monitor should assure that it is used in such an environment.			
Immunity test	**IEC60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**
Electrostatic discharge (ESD) IEC 61000-4-2	±6 kV contact ±8 kV air	±6 kV contact ±8 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC 61000-4-4	±2 kV for power supply lines ±1 kV I/O for input/output lines (>3 m)	±2 kV for power supply lines ±1 kV I/O for input/output lines (>3 m)	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	±1 kV differential mode ±2 kV common mode	±1 kV differential mode ±2 kV common mode	
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	<5 % U_T (>95 % dip in U_T) for 0.5 cycle 40 % U_T (60 % dip in U_T) for 5 cycles 70 % U_T (30 % dip in U_T) for 25 cycles <5 % U_T (>95 % dip in U_T) for 5 s	<5 % U_T (>95 % dip in U_T) for 0.5 cycle 40 % U_T (60 % dip in U_T) for 5 cycles 70 % U_T (30 % dip in U_T) for 25 cycles <5 % U_T (>95 % dip in U_T) for 5 s	Mains power quality should be that of a typical commercial or hospital environment. If the user of our product requires continued operation during power mains interruptions, it is recommended that our product be powered from an uninterruptible power supply or a battery.
Power frequency (50/60 HZ) magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
Note: U_T is the AC mains voltage prior to application of the test level.			

Guidance and Declaration - Electromagnetic Immunity		
The patient monitor is suitable for use in the electromagnetic environment specified below. The customer or the user of the patient monitor should assure that it is used in such an environment.		
Immunity test	**IEC 60601 Test level**	**Compliance level**
Conduced RF IEC61000-4-6	3 Vrms 150k to 80M Hz	3 Vrms (BIS, ICG: 1Vrms)
Radiated RF IEC61000-4-3	3V/m 80M to 2.5G Hz	3V/m (Resp: 1V/m)
Electromagnetic environment - guidance		
Portable and mobile RF communications equipment should be used no closer to any part of the patient monitor, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. Recommended Separation Distance: $d = 1.2\sqrt{P}$ (BIS, ICG: $d = 3.5\sqrt{P}$) $d = 1.2\sqrt{P}$ (Resp: $d = 3.5\sqrt{P}$) 80 to 800 MHz $d = 2.3\sqrt{P}$ 800M to 2.5GHz where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey, [a] should be less than the compliance level in each frequency range [b] Interference may occur in the vicinity of equipment marked with the following symbol: .		
Note 1: From 80 MHz to 800 MHz, the higher frequency range applies. Note 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.		
a Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the patient monitor is used exceeds the applicable RF compliance level above, the patient monitor should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the patient monitor. b Over the frequency ranges 150kHz to 80MHz, field strengths should be less than 3V/m.		

Recommended Separation Distances between Portable and Mobile RF Communications Equipment and The patient monitor

The patient monitor is suitable for use in an electromagnetic environment in which radiated RF disturbance are controlled. The customer or the user of the patient monitor can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the patient monitor as recommended below, according to the maximum output power of the communication equipment.

Rated Maximum Output power of Transmitter Watts (W)	**Separation Distance Meters (m) Corresponding to Frequency of Transmitter**		
	150k to 80MHz $d = \left[\frac{3.5}{3}\right]\sqrt{P}$	80M to 800MHz $d = \left[\frac{3.5}{3}\right]\sqrt{P}$	800M to 2.5GHz $d = \left[\frac{7}{3}\right]\sqrt{P}$
0.01	0.35	0.35	0.23
0.1	1.11	1.11	0.74
1	3.5	3.5	2.34
10	11.07	11.07	7.38
100	35	35	23.34

For transmitters at a maximum output power not listed above, the separation distance can be estimated using the equation in the corresponding column, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

Note 1: From 80 MHz to 800 MHz, the separation distance for the higher frequency range applies.

Note 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

C Factory Defaults

This section lists the most important factory default settings. These settings are not user-adjustable. You can restore the factory default settings if necessary.

C.1 Patient Demographics

Patient Demographics	Factory Default Settings
Patient Cat.	Adu
Paced	No

C.2 Alarm Setup

Alarm Setup	Factory Default Settings
Alarm Volume	2
Latching Alarms	No
Alarm Sound	On
Alarm Pause Time	2 min
High Alarm Interval (s)	10
Med Alarm Interval (s)	20
Low Alarm Interval (s)	20

C.3 Screen Setup

Screen Setup	Factory Default Settings
Help	On
Sweep Mode	Refresh
Key Volume	2
Brightness	5

C.4 ECG Setup

ECG Setup	Adult	Pediatric	Neonate
Alm Source	Auto		
Alarm	On		
Alm Lev	Med		
Alm Rec	Off		
HR High	120	160	200
HR Low	50	75	100
Beat Vol	2		
Paced	No		
Lead Set	5-Lead		
ECG Display	Normal		
Filter	Diagnostic		
Notch Filter	Off		
Defib. Sync	Off		

ST Analysis	Adult	Pediatric	Neonate
ST Analysis	Off		
Alarm	Off		
Alm Lev	Med		
Alm Rec	Off		
ST-X High*	0.2		
ST-X Low*	-0.2		
*: X represents I, II, III, aVR, aVL, aVF, V, V1, V2, V3, V4, V5 or V6.			

Arrh. Analysis	Adult	Pediatric	Neonate
Arrh. Analysis	On		
PVCs Alarm	Off		
Alm Lev	Med		
Alm Rec	Off		
PVCs High	10		

Arrh. Alarm Setup	Alarm	Alm Lev	Alm Rec
Asystole	On	High	Off
VFib/VTac	On	High	Off
R on T	On	Med	Off
VT>2	On	Med	Off
Couplet	On	Med	Off
PVC	On	Med	Off
Bigeminy	On	Med	Off
Trigeminy	On	Med	Off
Tachy	On	Med	Off
Brady	On	Med	Off
PNP	On	Med	Off
PNC	On	Med	Off
Missed Beat	On	Med	Off

Waveform X *	Adult	Pediatric	Neonate
HR Source	II		
Gain	X1		
Filter	Diagnostic		
Sweep	25 mm/s		
Cascade	Off		
*: X represents (lead) I, II, III, aVR, aVL, aVF, V, V1, V2, V3, V4, V5 or V6			

C.5 Resp Setup

Resp Setup	Adult	Pediatric	Neonate
Alarm	On		
Alm Lev	Med		
Alm Rec	Off		
Resp High	30	30	100
Resp Low	8	8	30
Apnea Time	20 s		
Detection Mode	Auto		
Resp Waveform			

Lead	II
Sweep	12.5 mm/s
Gain	X2
Detection Mode	Auto

C.6 SpO_2 Setup

SpO_2 Setup	**Adult**	**Pediatric**	**Neonate**
Alarm	On		
Alm Lev	Med		
Alm Rec	Off		
SpO2 High	100	100	95
SpO2 Low	90	90	80
Desat Limit	80	80	70
Sensitivity Mindray)	Med		
Sensitivity (Masimo)	Normal		
Averaging (Masimo, Nellcor)	8 s		
NIBP Simul	Off		
Sat-Seconds (Nellcor)	0 s		
PR Setup	**Adult**	**Pediatric**	**Neonate**
PR	On		
Alarm	On		
Alm Lev	Med		
Alm Rec	Off		
PR High	120	160	200
PR Low	50	75	100
Alm Source	Auto		
Beat Vol	2		
Pleth Waveform			
Sweep	25 mm/s		

C.7 NIBP Setup

NIBP Setup	Adult	Pediatric	Neonate
Alarm	On		
Alm Lev	Med		
Alm Rec	Off		
Alm Source	All		
Sys High	160	120	90
Sys Low	90	70	40
Mean High	110	90	70
Mean Low	60	50	25
Dia High	90	70	60
Dia Low	50	40	20
Display NIBP	Single-group		
Press. Unit	mmHg		
Interval	Manual		
Cuff Press.	80	60	40

C.8 Temp Setup

Temp Setup	Adult	Pediatric	Neonate
Alarm	On		
Alm Lev	Med		
Alm Rec	Off		
T1 High	39.0	39.0	39.0
T1 Low	36.0	36.0	36.0
T2 High	39.0	39.0	39.0
T2 Low	36.0	36.0	36.0
TD High	2.0	2.0	2.0
Unit	ºC		

C.9 IBP Setup

IBP Setup		**Adult**	**Pediatric**	**Neonate**
Alarm		On		
Alm Lev		Med		
Alm Rec		Off		
Alm Source		All		
Alarm Limits		**Systolic/Diastolic (Mean) (mmHg)**		
		Adult	**Pediatric**	**Adult**
Art, Ao, FAP, BAP, UAP	High Limit	160/90 (110)	120/70 (90)	90/60 (70)
	Low Limit	90/50 (70)	70/40 (50)	55/20 (35)
PA	High Limit	35/16 (20)	60/4 (26)	60/4 (26)
	Low Limit	10/0 (0)	24/-4 (12)	24/-4 (12)
Custom pressures, P1 to P8	High Limit	160/90 (110)	120/70 (90)	90/60 (70)
	Low Limit	90/50 (70)	70/40 (50)	55/20 (35)
Alarm Limits		**Mean (cmH_2O)**		
		Adult	**Pediatric**	**Adult**
CVP, LAP, RAP, ICP, UVP	High Limit	7.4	2.9	2.9
	Low Limit	0.0	0.0	0.0
IBP Waveform				
Sweep		25 mm/s		
Filter		No Filter		

C.10 C.O. Setup

C.O. Setup	Factory default settings
Alarm	On
Alm Lev	Med
Alm Rec	Off
BT High	39.0
BT Low	36.0
Comp. Const	0.542
Auto IT	Auto
Manual IT	2.0
Temp Unit	ºC
Interval (s)	30

C.11 CO_2 Setup

CO_2 Setup	**Factory default settings**		
	Adult	**Pediatric**	**Adult**
Alarm	On		
Alm Lev	Med		
Alm Rec	Off		
Humidity Compen (side/microstream)	Wet		
Press. Unit	mmHg		
Max Hold (microstream)	20 s		
Max Hold (mainstream)	10 s		
Operating Mode (side/mainstream)	Standby		
Operating Mode (microstream)	Measure		
O2 Compen (side/mainstream)	Off		
N2O Compen (sidestream)	Off		
Des Compen (sidestream)	Off		
Balance Gas (mainstream)	Room Air		
Auto Standby (min) (microstream)	0		
EtCO2 High	50	50	45
EtCO2 Low	15	20	30
FiCO2 High	4	4	4
awRR High	30	30	100
awRR High	8	8	30
Apnea Time	20 s		
CO_2 Waveform			
Wave Type	Draw		
Sweep	25 mm/s		

C.12 AG Setup

AG Setup	Factory default settings
Alarm	On
Alm Lev	Med
Alm Rec	Off
Apnea Time	20 s
Flow Rate	Low
O2 Compen	Off
Operating Mode	Standby
Auto Standby	Off
Wave Type (CO2)	Draw
Sweep	12.5 mm/s

Alarm Limits Setup	Adult/pediatric/neonate	Alarm Limits Setup	Adult/pediatric/neonate
awRR High	30/30/100	awRR Low	8/8/30
EtCO2 High	50/50/45	EtO2 High	684
EtCO2 Low	15/15/30	EtO2 Low	137
FiCO2 High	4	FiO2 High	669
FiCO2 Low	0	FiO2 Low	137
EtN2O High	55	EtHal High	3.0
EtN2O Low	0	EtHal Low	0.0
FiN2O High	53	FiHal High	2.0
FiN2O Low	0	FiHal Low	0.0
EtEnf High	3.0	EtIso High	3.0
EtEnf Low	0.0	EtIso Low	0.0
EtEnf High	2.0	EtIso High	2.0
EtEnf Low	0.0	EtIso Low	0.0
EtSev High	6.0	EtDes High	8.0
EtSev Low	0.0	EtDes Low	0.0
FiSev High	5.0	FiDes High	6.0
FiSev Low	0.0	FiDes Low	0.0

C.13 ICG Setup

ICG Setup	Factory default settings		
	Adult	**Pediatric**	**Neonate**
Alarm	On		
Alm Lev	Med		
Alm Rec	Off		
C.I. High	5.0		
C.I. Low	1.5		
TFC High	60		
TFC Low	10		
Averaging	30 beats		
Update Rate	10 beats		
Patient Demographics			
LV_D	50		
PAWP	10		
CVP	6		
ICG Waveform			
Sweep	12.5 mm/s		

C.14 BIS Setup

BIS Setup	Factory default settings		
	Adult	**Pediatric**	**Neonate**
Alarm	On		
Alm Lev	Med		
Alm Rec	Off		
BIS High	70		
BIS Low	20		
Smoothing Rate	30 s		
BIS EEG Waveform			
Sweep	25 mm/s		

C.15 RM Setup

RM Setup	Factory default settings		
	Adult	**Pediatric**	**Neonate**
Alarm	On		
Alm Lev	Med		
Alm Rec	Off		
Apnea Time	20 s		
TV / MV	TV		
Sensor Type	Disposable		
Ventilation Mode	Spontaneous		
Alarm Limits Setup			
RR High	30	30	100
RR Low	8	8	30
PEEP High	10		
PEEP Low	0		
PIP High	40		
PIP Low	1		
MVe High	30.0	30.0	10.0
MVe Low	2.0	2.0	0.5
RM Waveform			
Sweep	25 mm/s		

D Alarm Messages

This chapter lists only the most important physiological and technical alarm messages. Some messages appearing on your monitor may not be included.

In this chapter:

- The “A” field indicates whether all alarm indications can be cleared or not, and the “B” field indicates whether all alarm indications except the alarm message can be cleared or not.
- The “L” field indicates the alarm level: H means high, M means medium and L means low. “*” means the alarm level is user-adjustable.
- XX represents a measurement or parameter label, such as ECG, NIBP, HR, ST-I, PVCs, RR, SpO_2, PR, etc.

In the “Cause and Solution” column, corresponding solutions are given instructing you to troubleshoot problems. If the problem persists, contact your service personnel.

D.1 Physiological Alarm Messages

Measurement	Alarm messages	L	Cause and solution
XX	XX Too High	M*	XX value has risen above the high alarm limit or fallen below the low alarm limit. Check the patient's condition and check if the patient category and alarm limit settings are correct.
	XX Too Low	M*	
ECG	ECG Weak Signal	H	The ECG signal is so weak that the monitor can't perform ECG analysis. Check the patient's condition and the ECG connections.
	Asystole	H*	Arrhythmia has occurred to the patient. Check the patient's condition and the ECG connections.
	VFib/VTac	H*	
	R on T	M*	
	VT>2	M*	
	Couplet	M*	
	PVC	M*	
	Bigeminy	M*	
	Trigeminy	M*	
	Tachy	M*	
	Brady	M*	
	Missed Beats	M*	
	PNP	M*	The pacer appears abnormal. Check the pacer.
	PNC	M*	
Resp	Resp Apnea	H	The respiration signal was so weak that the monitor cannot perform respiration analysis. Check the patient's condition and the Resp connections.
	Resp Artifact	H	The patient's heartbeat has interfered with his respiration. Check the patient's condition and the Resp connections.
SpO_2	SpO2 Desat	H	The SpO2 value has fallen below the desaturation alarm limit. Check the patient's condition and check if the alarm limit settings are correct.
	No Pulse	H	The pulse signal was so weak that the monitor cannot perform pulse analysis. Check the patient's condition, SpO_2 sensor and measurement site.
CO_2	CO_2 Apnea	H	The respiration signal was so weak that the monitor cannot perform respiration analysis. Check the patient's condition and the RM connections.
AG	AG Apnea	H	
RM	RM Apnea	H	

D.2 Technical Alarm Messages

Measurement	Alarm message	A	B	Cause and solution
XX	XX SelfTest Err	√	×	An error occurred to the XX module, or there is a problem with the communications between the module and the monitor. Re-plug the module and restart the monitor, or plug the module into another monitor.
	XX Init Err	√	×	
	XX Init Err N	√	×	
	N is within 1 to 8			
	XX Comm Err	√	×	
	XX Comm Stop	×	×	
	XX Limit Err	×	×	XX parameter limit is accidentally changed. Contact your service personnel.
	XX Overrange	×	×	The measured XX value is not within the specified range for XX measurement. Contact your service personnel.
MPM	MPM 12V Err	×	×	An error occurred to the power supply part of the MPM module. Contact your service personnel.
	MPM 5V Err	×	×	
ECG	ECG Lead Off	×	√	The electrode has become detached from the patient or the lead wire has become disconnected from the adapter cable. Check the connection of the electrodes and leadwires.
	ECG YY Lead Off ECG	×	√	
	Note: YY represents the leadwires, V (V1, V2, V3, V4, V5, V6,), LL, LA, RA, as per AHA standard, or C (C1, C2, C3, C4, C5, C6), F, L and R as per IEC standard.			
	ECG Noisy	√	×	The ECG signal is noisy. Check for any possible sources of signal noise form the area around the cable and electrode, and check the patient for great motion.
	ECG Signal Invalid	×	√	The ECG signal is saturated. Check the leadwires.
Resp	Resp Disturbed	√	×	The respiration circuit is disturbed. Restart the monitor.
Temp	Temp Cal. Err	×	×	A calibration failed. Restart the monitor.
	T1 Sensor Off	√	×	The Temp sensor has become detached from the patient or the module. Check the sensor connections.
	T2 Sensor Off	√	×	
SpO_2	SpO2 Sensor Off	√	×	The SpO_2 sensor has become detached from the

Measurement	Alarm message	A	B	Cause and solution
	SpO2 Sensor Fault	×	×	patient or the module, or there is a fault with the SpO_2 sensor, or an unspecified SpO_2 sensor has been used. Check the sensor application site and the sensor type, and make sure if the sensor is damaged. Reconnect the sensor or use a new sensor.
	SpO2 No Sensor	√	×	
	SpO2 Unrecognized Sensor	×	×	
	SpO2 Sensor Incompatible	×	×	
	SpO_2 Too Much Light	×	×	There is too much light on the SpO_2 sensor. Move the sensor to a place with lower level of ambient light or cover the sensor to minimize the ambient light.
	SpO2 Low Signal	×	×	The SpO2 signal is too low or too weak. Check the patient's condition and change the sensor application site. If the error persists, replace the sensor.
	SpO2 Weak Signal	×	×	
	SpO2 Weak Pulse	×	×	
	SpO2 Low Perf	×	×	
	SpO2 Interference	×	×	The SpO2 signal has been interfered. Check for any possible sources of signal noise from the area around the sensor and check the patient for great motion.
	SpO2 Board Fault	×	×	There is a problem with the SpO_2 measurement board. Do not use the module and contact your service personnel.
NIBP	NIBP Loose Cuff	√	×	The NIBP cuff is not properly connected, or there is a leak in the airway.
	NIBP Air Leak	√	×	
	NIBP Pneumatic Leak	√	×	Check the NIBP cuff and pump for leakages.
	NIBP Cuff Type Wrong	√	×	The cuff type applied mismatches the patient category. Verify the patient category and replace the cuff.
	NIBP Air Pressure Err	√	×	An error occurred to the air pressure. Verify that the monitor application site meets the environmental requirements and check if there is any source that affects the air pressure.
	NIBP Weak Signal	√	×	The patient's pulse is weak or the cuff is loose. Check the patient's condition and change the cuff application site. If the error persists, replace the cuff.
	NIBP Signal Saturated	√	×	The NIBP signal is saturated due to excess motion or other sources.

Measurement	Alarm message	A	B	Cause and solution
	NIBP Overrange	√	×	The measured NIBP value is not within the specified range.
	NIBP Excessive Motion	√	×	Check the patient's condition and reduce the patient motion.
	NIBP Cuff Overpress.	√	×	The NIBP airway may be occluded. Check the airway and measure again.
	NIBP Equip Err	√	×	An error occurred during NIBP measurement and therefore the monitor cannot perform analysis correctly. Check the patient's condition and NIBP connections, or replace the cuff.
	NIBP Timeout	√	×	
	NIBP Measure Failed	√	×	
	NIBP Illegally Reset	√	×	An illegal reset occurred during NIBP measurement. Check if the airway is occluded.
IBP	YY Sensor Off	√	×	Check the sensor connection and reconnect the sensor.
	YY represents an IBP label.			
C.O.	BT Sensor Off	√	×	
CO2	CO_2 Sensor Off	×	√	
	CO_2 Internal Comm Err	√		There is a problem with the communication between the CO_2 module and the monitor.
	CO_2 Sensor High Temp	×	×	Check, stop using or replace the sensor.
	CO_2 Sensor Low Temp	×	×	Check, stop using or replace the sensor.
	CO_2 Sensor Fault	×	×	Check, stop using or replace the sensor.
	CO_2 Airway High Press.	×	×	An error occurred in the airway pressure. Check the patient connection and patient circuit, and then restart the monitor.
	CO_2 Airway Low Press.	×	×	
	CO_2 High Barometric Press.	×	×	Check the CO2 connections, make sure that the monitor application site meets the requirements, and check for special sources that affect the ambient pressure. Restart the monitor.
	CO_2 Low Barometric Press.	×	×	
	CO_2 FilterLine Occluded	×	×	The airway or watertrap was occluded. Check the airway and remove the occlusion.
	CO_2 Watertrap Occluded	×	×	
	CO_2 No Watertrap	×	√	Check the watertrap connections.
	CO_2 Signal Saturated	√	×	There is a problem with the CO2 signal quality. Check the CO2 connections.
	CO_2 Signal Low	√	×	
	CO_2 Signal Too Low	√	×	
	CO_2 Signal Noisy	√	×	

Measurement	Alarm message	A	B	Cause and solution
	CO_2 Calc. Err	√	×	
	CO_2 Check Adapter	√	×	There is a problem with the airway adapter. Check, clean or replace the adapter.
	CO_2 Zero Required	×	√	A zero calibration is required.
	CO_2 FilterLine Err	×	×	Check if there is a leak in the CO_2 sample line or the CO_2 sample line has been occluded.
	CO_2 Zero Failed	√	×	Check the CO_2 connections. After the sensor's temperature becomes stabilized, perform a zero calibration again.
	CO_2 System Err	√	×	Re-plug the module or restart the monitor.
	CO_2 Check Cal.	×	×	Perform a calibration.
	CO_2 Check Airway	×	×	An error occurred to the airway.
	CO_2 No Filterline	√	×	Make sure that the filterline is connected.
	CO_2 Main Board Err	×	×	There is a problem with the CO_2 module. Re-plug the module or restart the monitor.
	CO_2 Check Sensor or Main Board	×	×	
	CO_2 Replace Scrubber&Pump	×	×	
	CO_2 Change Sensor	×	×	
	CO_2 15V Overrange	×	×	
	CO_2 Hardware Err	×	×	
	CO_2 Pump Fault	×	×	
	CO_2 Pneumatic Leak	√	×	
	CO_2 Malfunction	×	×	
	CO_2 Reverse Flow	×	×	The gas inlet has been connected to a negative pressure source or vacuum device and therefore the module works abnormally when the pump starts up. Check the gas inlet.
	CO_2 Forward Flow	×	×	The gas inlet has been connected to a positive pressure source or an airflow source and therefore the module works abnormally when the pump starts up. Check the gas inlet.
AG	CO_2 Sensor Off	√	×	Check the connections of the sensor and re-connect it.
	AG No Watertrap	×	√	Check the connections of the watertrap and re-connect it.

Measurement	Alarm message	A	B	Cause and solution
	AG Change Watertrap	√	×	Wait until the change is completed.
	AG Watertrap Type Wrong	√	×	Make sure that a correct watertrap has been used.
	O2 Accuracy Unspecified	×	√	The measured value has exceeded the specified accuracy range.
	N2O Accuracy Unspecified	√	×	
	CO2 Accuracy Unspecified	√	×	
	Enf Accuracy Unspecified	√	×	
	Iso Accuracy Unspecified	√	×	
	Sev Accuracy Unspecified	√	×	
	Hal Accuracy Unspecified	√	×	
	Des Accuracy Unspecified	√	×	
	RR Accuracy Unspecified	√	×	
	O2 Sensor Err	√	×	An error occurred to the module. Re-plug the module or restart the monitor.
	Galvanic O2 Sensor Err	√	×	
	AG Hardware Err	√	×	
	AG Airway Occluded	√	×	Check the airway and remove the occlusion.
	AG Zero Failed	√	×	Re-plug the module or restart the monitor, and then perform a zero calibration again.
	AG Oxima Depletion Err	√	×	Contact your service personnel and replace the O2 battery.
	AG Oxima Depletion Warn	√	×	
	AG Accuracy Err	√	×	The measured value has exceeded the specified accuracy range.
RM	RM No Sensor	√	×	Check and reconnect the sensor.
	RM Sensor Reversed	×	×	
	Zero Failed	×	×	Perform a zero calibration again.
	RM Power Err	×	√	There is a problem with the power supply. Re-plug the module or restart the monitor.
BIS	BIS High Imped.	√	×	Check and reconnect the BIS sensor.
	BIS Sensor Off	√	×	
	BIS DSC Err	×	×	An error occurred to the DSC during receiving signals. Check the DSC.
	BIS DSC Malf	×	×	The DSC automatically shuts down as a result of malfunction. Check the DSC.

Measurement	Alarm message	A	B	Cause and solution
	BIS No Cable	√	×	Check the BIS cables.
	BIS No Sensor	√	×	Check the BIS sensor.
	BIS Sensor Err	√	×	Check or replace the sensor.
	BIS Sensor Excessively Used	√	×	Replace the sensor.
	SQI<50%	√	×	The SQI value is too low. Check the patient's condition and the sensor connections.
	SQI<15%	√	×	
	BIS Sensor Expired	√	×	Replace the sensor.
ICG	ICG Low Quality Signal	√	×	Check and reconnect the sensor.
	ICG Left Neck Sensor Off	√	×	
	ICG Right Neck Sensor Off	√	×	
	ICG L. Thorax Sensor Off	√	×	
	ICG R. Thorax Sensor Off	√	×	
	ICG Sensor Off	√	×	
Power	12V Too High	√	×	There is a problem with the system power supply. Restart the monitor.
	12V Too Low	√	×	
	5V Too High	√	×	
	5V Too Low	√	×	
	3.3V Too High	√	×	
	3.3V Too Low	√	×	
	Battery Too Low	√	×	Connect the monitor to an AC power source and allow the batteries to charge.
	Different Battery Voltages	√	×	The two batteries have different charge capacity, or the batteries unspecified have been used, or there is a problem with the batteries. Make sure that correct batteries are used and the batteries are not damaged, or replace the batteries.
	Battery Incompatible	×	×	
	Battery Error	×	×	
	Cell Battery Too High			There is a problem with the power supply for the realtime clock. Restart the monitor.
	Cell Battery Too Low			
	Battery Power Overload			The power consumption of the equipment is too high. Power the monitor using an AC power source.
	RT Clock Need Reset	√	×	Re-set the system time and restart the monitor.
	RT Clock Not Exist	√	×	Contact your service personnel.
	Charger Error	×	×	Contact your service personnel.

Measurement	Alarm message	A	B	Cause and solution
Recorder	Recorder Init Err N	×	√	Restart the monitor.
	N is within 1 to 8.			
	Recorder SelfTest Err	×	√	Stop the recording and restart the monitor.
	Recorder Comm Err	×	√	
	Recorder S. Comm Err	×	√	
	Recorder Unavailable	√	×	
	Recorder Vlt High	√	×	An error occurred to the system power supply. Restart the monitor.
	Recorder Vlt Low	√	×	
	Recorder Head Hot	√	×	The recorder has been working for too long time. Stop the recording and resume the recording till the recorder's printhead cools down.
	Recorder out of Paper			Open the recorder door and load a new roll of recorder paper.
	Rec Paper Wrong Pos.	×	√	Re-load the recorder paper.
System	System Watchdog Err	√	×	An error occurred to the system. Restart the monitor.
	System Software Err	√	×	
	System CMOS Full	√	×	
	System CMOS Err	√	×	
	System FPGA Err	√	×	
	System Err N	√	×	
	N is within 2 to 12.			
	Keyboard Init Err	√	×	Re-plug the keyboard and restart the monitor.
	Keyboard Unavailable	√	×	
	Keyboard Comm Err	√	×	
	Keyboard failed. Please shut down!	√	×	
	Key Error	√	×	An error occurred to the system. Restart the monitor.
	System Bus Err	√	×	
	Net Init Err	√	×	
	Net Bus Err	√	×	
	USB Bus Init Error	√	×	
	System Connected	√	×	The monitor is successfully connected to the monitoring network.

Measurement	Alarm message	A	B	Cause and solution
	System Not Connected	√	×	Check the connection of the network cable and contact the network administrator.
	SMR Unavailable	√	×	Turn off the monitor and check the connection between the satellite module rack (SMR) and the monitor, and then restart the monitor.
	Net Comm Error	×	√	Check the network connections and contact the network administrator.
	CF Storage Card Err!	×	√	The CF storage card has been damaged, or has stored data from other equipment. Contact your service personnel.

E Symbols and Abbreviations

E.1 Symbols

µA	microampere
µV	microvolt
A	ampere
Ah	ampere hour
bpm	beat per minute
bps	bit per second
ºC	centigrade
cc	cubic centimeter
cm	centimeter
dB	decibel
DS	dyne second
ºF	fahrenheit
g	gram
GHz	gigahertz
GTT	gutta
h	hour
Hz	hertz
in	inch
kg	kilogram
kPa	kilopascal
L	litre
lb	pound
m	meter
mAh	microampere hour
Mb	mega byte
mcg	microgram
mEq	milli-equivalents
mg	milligram
min	minute
ml	milliliter
mm	millimeter
mmHg	millimeters of mercury
ms	millisecond
mV	millivolt
mW	milliwatt
MΩ	megaohm

nm	nanometer
rpm	breath per minute
s	second
V	volt
VA	volt ampere
Ω	ohm
W	watt
–	minus
%	percent
/	per; divide; or
+	plus
=	equal to
<	less than
>	greater than
≤	less than or equal to
≥	greater than or equal to
±	plus or minus
×	multiply

E.2 Abbreviations

$AaDO_2$	alveolar-arterial oxygen gradient
AAMI	Association for Advancement of Medical Instrumentation
AC	alternating current
ACI	acceleration index
Adu	adult
AG	anaesthesia gas
AHA	American Heart Association
ANSI	American National Standard Institute
Art	arterial
aVF	left foot augmented lead
aVL	left arm augmented lead
aVR	right arm augmented lead
awRR	airway respiratory rate
BAP	brachial aterial pressure
BIS	bispectral index
BP	blood pressure
BPSK	binary phase shift keying
BSA	body surface area
BT	blood temperature
BTPS	body temperature and pressure, saturated
C.I.	cardiac index
C.O.	cardiac output
CaO_2	arterial oxygen content
CCO	continuous cardiac output
CCU	cardiac (coronary) care unit
CE	Conformité Européenne
CIS	Clinical Information System
CISPR	International Special Committee on Radio Interference
CMOS	complementary metal oxide semiconductor
CMS	central monitoring system
C.O.	cardiac output
CO_2	carbon dioxide
COHb	carboxyhemoglobin
CP	cardiopulmonary
CVP	central venous pressure
DC	direct current
Des	desflurane
Dia	diastolic
DPI	dot per inch
DVI	digital video interface

ECG	electrocardiograph
EEC	European Economic Community
EEG	electroencephalogram
EF	ejection fraction
EMC	electromagnetic compatibility
EMG	electromyography
EMI	electromagnetic interference
Enf	enflurane
ESU	electrosurgical unit
Et	end-tidal
$EtCO_2$	end-tidal carbon dioxide
EtN_2O	end-tidal nitrous oxide
EtO	ethylene oxide
EtO_2	end-tidal oxygen
FAP	femoral arterial pressure
FCC	Federal Communication Commission
FDA	Food and Drug Administration
FEV1.0%	first second forced expiratory volume ratio
Fi	fraction of inspired
$FiCO_2$	fraction of inspired carbon oxygen
FiN_2O	fraction of inspired nitrous oxide
FiO_2	fraction of inspired oxygen
FPGA	field programmable gate array
FV	flow-volume
Hal	halothane
Hb	hemoglobin
Hb-CO	carbon mono-oxide hemoglobin
HbO_2	oxyhemoglobin
HR	heart rate
I:E	inspiratory-expiratory ratio
IBP	invasive brood pressure
ICG	impedance cardiography
ICP	intracranial pressure
ICT/B	intracranial catheter tip pressure transducer
ICU	intensive care unit
ID	identification
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
Ins	inspired minimum
IP	internet protocol
Iso	isoflurane
IT	injectate temperature
LA	left arm
LAP	left atrial pressure

Lat	lateral
LCD	liquid crystal display
LCW	left cardiac work
LCWI	left cardiac work index
LED	light emitting diode
LL	left leg
LVD	low voltage directive
LV_D	left ventricular diameter
LVDS	low voltage differential signal
LVET	left ventricular ejection time
LVSW	left ventricular stroke work
LVSWI	left ventricular stroke work index
MAC	minimal alveolar concentration
MAP	mean arterial pressure
MDD	Medical Device Directive
MetHb	methemoglobin
MRI	magnetic resonance imaging
MVe	expiratory minute volume
MVi	inspiratory minute volume
N/A	not applied
N_2	nitrogen
N_2O	nitrous oxide
Neo	neonate
NIBP	noninvasive blood pressure
NIP	negative inspiratory pressure
O_2	oxygen
O_2CI	oxygen consumption index
O_2R	oxygen extraction ratio
OR	operating room
oxyCRG	oxygen cardio-respirogram
PA	pulmonary artery
Paw	airway pressure
PAWP	pulmonary artery wedge pressure
PD	photodetector
Ped	pediatric
PEEP	positive end expiratory pressure
PEF	peak expiratory flow
PEP	pre-ejection period
PIF	peak inspiratory flow
PIP	peak inspiratory pressure
Pleth	plethysmogram
Pmean	mean pressure
Pplat	plateau pressure
PR	pulse rate

PVCs	premature ventricular complex
PVR	pulmonary vascular resistance
PVRI	pulmonary vascular resistance index
R	right
RA	right arm
RAM	random access memory
RAP	right atrial pressure
Raw	airway resistance
RCW	right cardiac work
RCWI	right cardiac work index
Rec	record, recording
RESP	respiration
RHb	reduced hemoglobin
RL	right leg
RM	respiratory mechanics
RR	respiration rate
RSBI	rapid shallow breathing index
RVSW	right ventricular stroke work
RVSWI	right ventricular stroke work index
SaO_2	arterial oxygen saturation
SEF	spectral edge frequency
Sev	sevoflurane
SFM	self-maintenance
SI	stroke index
SMR	satellite module rack
SpO_2	arterial oxygen saturation from pulse oximetry
SQI	signal quality index
SR	suppression ratio
STR	systolic time ratio
SV	stroke volume
SVR	systemic vascular resistance
SVRI	systemic vascular resistance index
Sync	synchronization
Sys	systolic pressure
Taxil	axillary temperature
TD	temperature difference
Temp	temperature
TFC	thoracic fluid content
TFI	thoracic fluid index
TFT	thin-film technology
Toral	oral temperature
TP	total power
Trect	rectal temperature
TVe	expiratory tidal volume

TVi	inspiratory tidal volume
UAP	umbilical arterial pressure
UPS	uninterruptible power supply
USB	universal serial bus
UVP	umbilical venous pressure
VAC	volts alternating current
VEPT	volume of electrically participating tissue
VI	velocity index
WLAN	wireless local area network
WOB	work of breathing